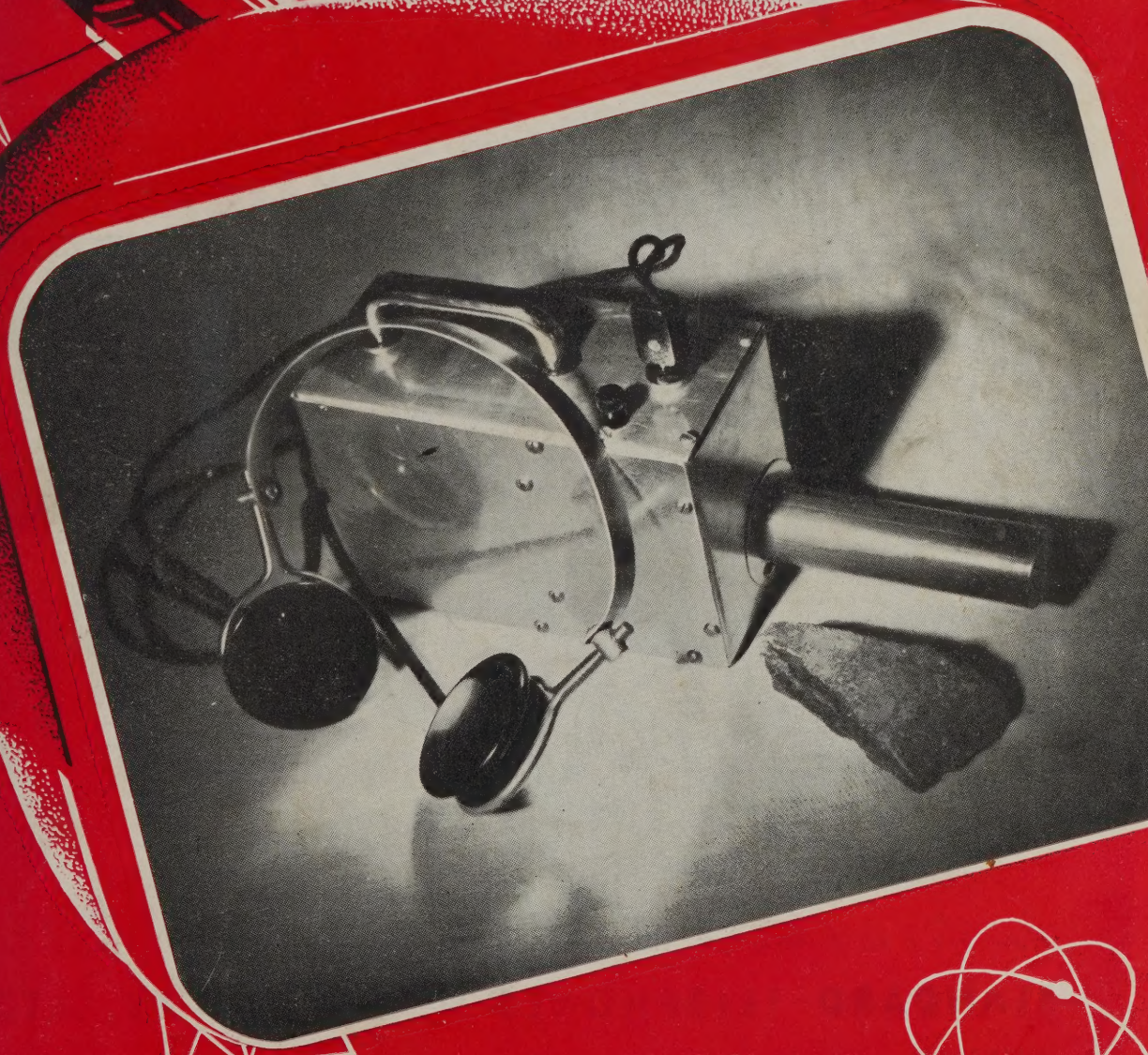
RADIO and ELECTRICAL Review

TELEVISION - COMMUNICATIONS - SERVICE - SOUND

Incorporating "RADIO and ELECTRONICS"



DECEMBER 1st, 1954

VOL. 9, NO. 10

PRICE 1/10

Radio and Electrical Review

OUR COVER

This month we show the complete Geiger counter which is described commencing on page 20 of this issue. The instrument is entirely self-contained, with its own battery supply. The current drain is exceedingly light, and should enable at least one prospecting trip to be undertaken without a change of batteries.

Official Journal of
The N.Z. Electronics Institute (Inc.).
The N.Z. Radio and Television Manufacturers' Federation.
The N.Z. Radio and Electrical Traders' Federation.
N.Z. Radio, TV and Electrical Assn. (Inc.).

Managing and Technical Director:
W. D. FOSTER, B.Sc.

Advertising Manageress:
Miss D. JAMIESON

Subscriptions:
1s. 10d. per copy; 23s. 6d. per annum, posted.
Advertising Rates supplied on application.

CORRESPONDENCE
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"Radio and Electrical Review,"
P.O. Box 8022,
Wellington, N.Z.

OFFICES AND LABORATORY:
Radio and Electronics (N.Z.), Ltd.,
46 Mercer Street, Wellington.
Telephone, Wellington, 70-216.
Telegrams and Cables:
"Radel," Wellington.

SOLE ADVERTISING REPRESENTATIVES for THE UNITED KINGDOM:
Cowlishaw and Lawrence (Advertising), Ltd., 28 New Bridge Street, London, E.C.4.
Telephone City 5118.
Cables: Cowlawads Cent, London.

VOL. 9, No. 10 1st DECEMBER, 1954

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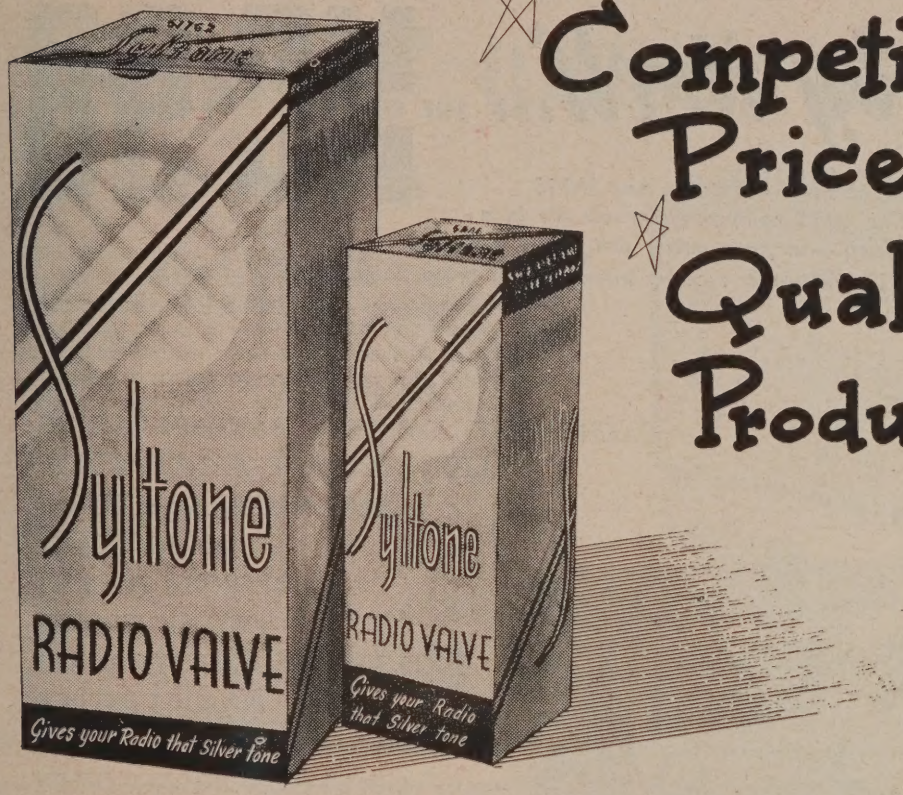
Sole New Zealand Distributors: Gordon & Gotch (N.Z.) Ltd., Wellington

PRINTED BY HARRY H. TOMBS, LTD., WINGFIELD STREET, WELLINGTON.



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1T4	6BA6	6K8GT	7R7	25L6GT
1U5	6BE6	6L6G	7S7	35L6GT
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Copies of original designs produced in our laboratory and featured in these pages are available. Prices are: Size 6 in. x 4 in. 3s. 6d.; 8 x 6, 4s. 6d.; 10 x 8, 5s. 6d. Please remit cash with order to Radio and Electronics (N.Z.) Ltd., P.O. Box 8022, Wellington.

High quality Low price

The new Trio Track Record Player has made this combination possible by new construction methods.

The old drawbacks of units of this type (audible "WOW" and high "rumble") have been eliminated, bringing the high-fidelity enthusiast a 3-speed record player of perfect performance.

Technical specifications.

RECORD PLAYER. Dimensions: base plate, 13 in. x 10 in.

Height above plate, 1.8 in.

Depth below base plate, 2.4 in.

Turntable fitted with removable rubber cover. Diameter, 8.3 in. Weight (net) 6.3 lb.

A special self-centring device for use with "45" records is supplied. The special patented start-and-stop mechanism permits the stylus to be lowered on to the record at any particular point without stopping the turntable. When stopping at the end of the record there is no resistance to the movement of the tone arm.

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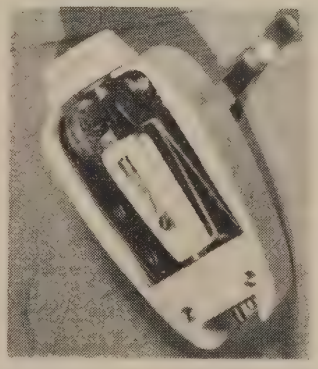
The pick-up head is removable.



The record-player is delivered with an automatic "track-finder" head. The last feature is an entirely new invention which largely facilitates placing the pick-up on the record. The "track-finder" may be placed anywhere on the record and will automatically by means of two small wheels, draw the pick-up towards the edge of the record and gently lower the sapphire into the entrance groove.

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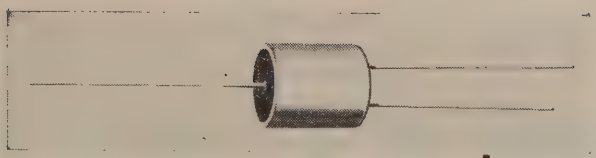
GREEN and COOPER LTD.

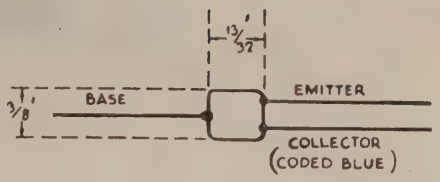
43 LOWER TARANAKI STREET, WELLINGTON. TELEPHONE 54-418.

Greetings from BEACON RADIO LTD.

To all our friends and customers in the radio and electrical trade, we extend the heartiest Seasonal Greetings for a very Merry Christmas and Happy New Year.

It is our sincere wish that we may in the coming year continue to enjoy the cordial relationship that helps to make our association with you a pleasant and mutually profitable one.



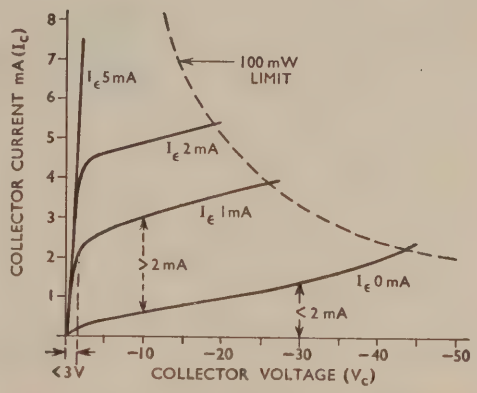


G.E.C.

Germanium Triode GET 1

POINT CONTACT TYPE

now available to all electronic equipment manufacturers



Many progressive designers have made full use of the range of G.E.C. germanium diodes to save power consumption and space.

Now the release of the GET 1 — a germanium triode (transistor) of the point contact type — will enable more designers to reap the benefits of this important development in radio and electronic engineering, where the potentialities of the GET 1 are manifold.

For further information write to Osram Valve and Electronics Dept.,

RATING

V_c (collector voltage) for short-circuit stability at $V_e=0$*	−30 max.	V
V_c (DC)	−50 max.	V
I_c (collector current) DC	15 max.	mA
T_{op} (operating temperature)	35 max.	°C
p_c (collector dissipation)	100 max.	mW

Subject to p_c max. not being exceeded.

*V_e = emitter voltage.

CHARACTERISTICS

I_c (at $V_c=-30$, I_e (emitter current) $=0$)	2 max.	mA
	1 average	mA
V (at $I_c=2$ mA)	3 max.	V
	1.5 average	V
I gain (at $V_c=-10$, I_e range 0–1mA)	2 min.	
	2.5 average	

GENERAL The GET 1 is hermetically sealed in a metal can, which is insulated from the electrodes. The can may be earthed when necessary.

BRITISH GENERAL ELECTRIC COMPANY LIMITED Wellington, Auckland, Christchurch Dunedin

Greetings for Christmas and the New Year

NEW ZEALAND RADIO AND TELEVISION MANUFACTURERS' FEDERATION

In conveying the Season's Greetings to all members of the N.Z. Radio Manufacturing Industry and the N.Z. Radio Wholesale and Retail Traders, I do so with a feeling of confidence in the future of the radio industry.

Never before has such excellent radio value and range of models been offered to the people of this Dominion and the healthy competitive spirit existing within the industry ensures that even better value and variety of models will be available in the future. Better service is being given by the trade and more advanced knowledge is being gained by our technicians, who are now called upon to design and service electronic and other intricate equipment. On such characteristics as service, knowledge and competitive enterprise has the radio industry been founded—with these same healthy attributes will it continue to grow.

May the esprit de corps which has always existed in our industry be even more evident as we approach the New Year, 1955.

I trust that the Christmas and New Year Season brings to all—health, happiness and prosperity.

D. T. CLIFTON-LEWIS,
President.

NEW ZEALAND RADIO TRADERS' FEDERATION

The year 1954 brought with it unprecedented prosperity to the Radio and Electrical trade. The few problems which existed, related to supply, Wholesalers and Manufacturers being unable on occasions to meet promptly, and in full, dealer requirements. However, despite this, the trade is in a very healthy state. There is good reason to believe that present prosperity will continue and that the year 1955 will see new Sales Records created.

While there still appears to be no immediate prospect of TELEVISION our Technical friends will, no doubt, be giving this closer study in 1955, so that our Industry will be prepared technically when it is called on to meet the exacting requirements of this complex phase of Electronics.

1954 also saw a common approach to problems by Radio Traders' groups and it may well be that 1955 will see the Radio Trade speaking with one voice.

To all I would extend my appreciation for what has been done during the past year to assist me in my office, and I would conclude by extending the time-honoured greeting of—

A MERRY CHRISTMAS AND A HAPPY NEW YEAR TO ALL.

NOEL SOUPER.
President.

NEW ZEALAND ELECTRONICS INSTITUTE (INC.)

In viewing this Year in retrospect, it is very pleasurable to report greatly increased activity in the South Island, while interest in the North Island is being well maintained.

The Executive Council is looking forward to definite achievements in the coming Year and amongst other things we hope to have the Constitution tidied up and the examination standards of the N.Z.E.I. Inc. published.

Fraternal greetings to all members.

WILLIAM L. SHIEL,
President, N.Z.E.I. Inc.

N.Z. RADIO, TV AND ELECTRICAL TRADERS' ASSOCIATION

With the festive season upon us once again, we look back and analyse what has transpired in the radio trade during the last twelve months. This period has seen certain changes, and I feel this will be for the benefit of the whole radio industry. However, looking at the situation on a broad basis, the trade has remained in an extremely buoyant state, despite difficult trading conditions with which all have been confronted. The most difficult situation to my mind that has occurred, is that of supply, which of course, has been aggravated by industrial trouble overseas.

In touching on these difficulties, I do so, not with a sense of pessimism, but rather one of optimism, in that this industry can face up to such difficulties in a manner that makes me very proud to be associated with the radio trade, knowing that, in spite of the troubles that traders generally are faced with, they face these with a grin, and still tend to forge ahead, full of enthusiasm and spirit. Such an outlook must definitely assist in overcoming all obstacles which industries are faced with from time to time.

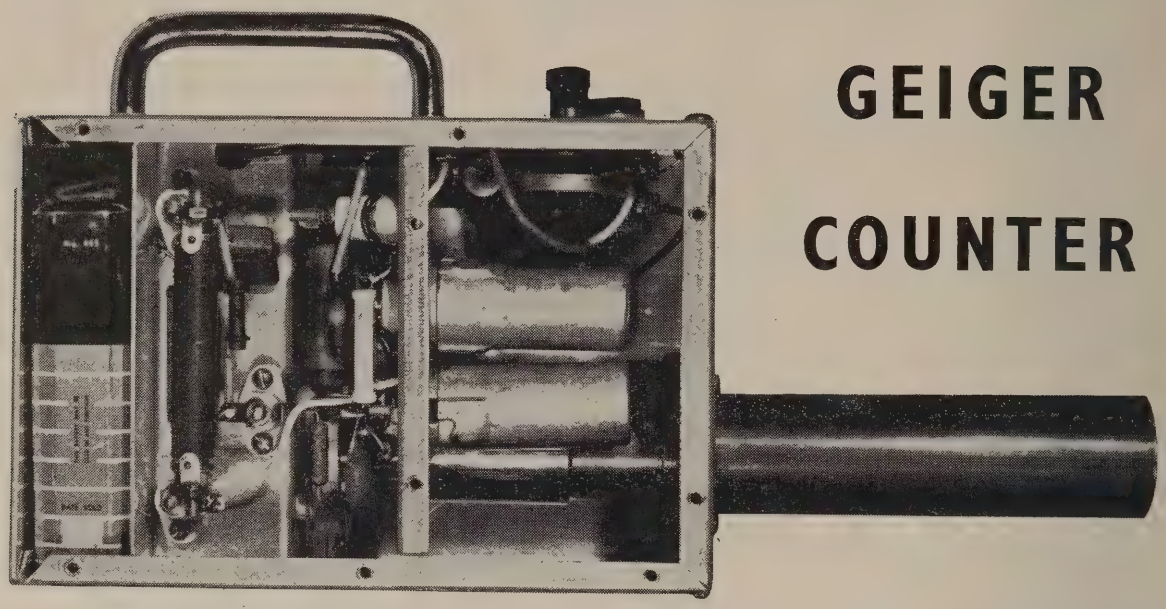
With this thought in mind, I feel confident that the forthcoming year will bring added strength and prosperous trading conditions to the radio trade generally.

I take the opportunity of expressing my very best wishes for Christmas and the forthcoming year to all members of the Radio and Electrical Trade throughout this Dominion.

Yours sincerely,

C. R. PEOPLES,
President.

THE R. & E. PORTABLE GEIGER COUNTER



INTRODUCTION

Those who are interested in the subject of Geiger counter equipment, and who have read the article by J. F. McCahon in last month's issue of "Radio and Electrical Review," will need no further introduction, but for those who have not read the article in question, a short description of what the equipment aims to do, and how it functions, will be necessary.

The use of the equipment is that it enables material to be tested for radioactivity. A sample suspected of possessing radioactive properties is merely brought close to the business end of the Geiger tube, which is conveniently mounted for the purpose, and, at the same time, the operator listens in the headphones which are also part of the equipment. Should radioactivity be present in appreciable quantities, the sharp clicks, which are normally heard to occur at a rate of a little more than one a second, increase markedly in their rate of arrival. A very active specimen may cause the clicking rate of the instrument to increase to such an extent that the individual clicks merge into a continuous roar.

At this point, the operator downs tools, carefully marks where he is on the map (if one exists), and hot-foots it back to civilization to report his find! This does not mean, however, that the instrument will observe only very large quantities of radiation. In point of fact, very minute quantities can be positively identified, and, in this respect, the instrument can be said to be very sensitive indeed. Until a few years ago, the special tube (the Geiger-Mueller, or simply Geiger tube, as it is called today) which detects the radiation from radioactive specimens was purely a laboratory instrument, and to make a portable battery-operated detector was hardly feasible. One of the difficulties (which still exists) was that the Geiger tube itself requires quite a high voltage in order to function at all. Early tubes required 50 to 100 per cent. more operating voltage than do present-day ones, and this, combined with the fact that valves and circuit developments had not reached their present pitch, made portable equipment very difficult to produce. Besides, there was not the incentive that exists at present, in the shape of very tangible rewards for the finding of radioactive deposits. Now, however, very light and compact radiation detectors can be built, operating from relatively low-voltage dry batteries, such as are commonly used for portable radio receivers, and these instruments will function for several months on a set of batteries. They therefore become quite practical devices, with which anyone can provide himself, either by purchasing a commercially produced instrument, or by building one for himself.

HOW RADIATION IS DETECTED

The radiation emitted by radioactive materials takes three forms, which were briefly described in the article referred to above, but, within limits, all three kinds are capable of being detected by Geiger tubes. Special designs of tube are built, specifically adapted to the detection of one or more of the three types, but the commonest kind of tube is the one, like that used for the instrument to be described, which detects γ-radiation most easily. This is because γ-rays are the most active of the three types of radiation, and can penetrate even great thicknesses of heavy metal, such as lead. Thus, a Geiger tube for detecting γ-radiation can have a metal envelope, like a metal radio valve, and still work perfectly. Structurally, the tube is very simple, consisting only of an insulated wire, supported in the centre of a metal cylinder, which forms the cathode. The tube is therefore a kind of diode, with the metal shell acting as the cathode, and the wire down the centre as the anode. Inside, the air is

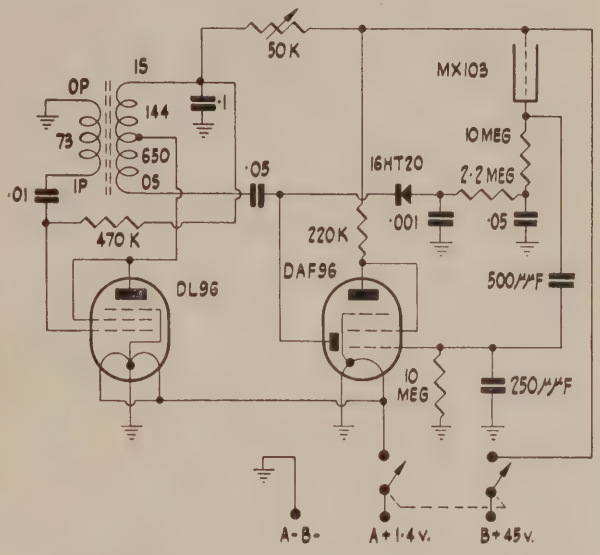
Last month we featured an article outlining the basic principles of Geiger counters, as applied to radiation measurements. This month, we follow up with the design of a portable battery-operated equipment which uses a Geiger tube type shortly to be available on the New Zealand market. The equipment is not complicated, and should be within the capability of any experimenter to build. Once operating, it will do all that might be required of it by the amateur or professional uranium prospector.

exhausted as in a radio valve, and a very minute quantity of a particular gas or organic vapour is introduced in an accurately known amount. A potential of some 400 volts is applied across the tube in such polarity that the anode is made positive with respect to the cathode. The amount of residual gas or vapour is so small that the applied potential does not cause any current at all to pass through the tube, except when a "count" occurs. It is what happens when a single γ-ray arrives and passes through the tube that is of interest to us. When this happens, a relatively few molecules of gas in the direct path of the radiation (or particle, whichever we prefer to call it) are ionized, so that free electrons are liberated. These electrons are strongly attracted by the anode, and rapidly make their way to it, causing a very brief pulse of current to flow through the tube. Perhaps it would be better to say that these electrons arriving at the anode of the tube actually constitute a pulse of current. Now, if we have a high resistance in series with the Geiger tube, this pulse of current causes a pulse of voltage to be generated across the load resistor. This voltage can be amplified and applied to a speaker or a pair of headphones, where the pulse causes a loud click to be heard.

This explanation is grossly over-simplified, for various reasons which we have not space to go into in what is really a practical article, and those who require a fuller explanation are therefore referred to the article mentioned earlier. This much should be sufficient to illustrate how the individual parcels of radiation each cause the Geiger tube to pass a pulse of current, which can be amplified and observed aurally. Now, radioactive radiation is not like that from a radio transmitter. That is to say, it is not continuous, but occurrs in small, discrete bursts, which can be regarded as particles, or as small bursts of radiation, each of extremely short duration. Every particle that passes through the Geiger tube produces an output pulse, or "count," and we distinguish between different degrees of radiation intensity, not by gauging the intensity of the individual pulses in any way, but merely by counting the number that occur in a given time. An intense source of radiation obviously causes more particles per second to pass through the tube and produce output pulses than a weaker source. In accurate work, such as is carried out in laboratories, means are available for counting the pulses very accurately, over any required period, whether a second, a minute, or an hour. For the elementary purpose of merely detecting radiation, however, it is necessary only to listen to the pulses as they occur and to gauge by ear whether their frequency has increased or not when the sample is brought near the Geiger tube.

THE BACKGROUND COUNT

When a Geiger counter is turned on in the absence of any radioactive material, it will be found that every now and again there is a count. With some tubes, the background count, as it is called, amounts to an average of some 60 to 80 a minute. This does not indicate that the counter is not working properly.



Circuit of the complete instrument. The transformer windings, which are made with 40-gauge enamelled wire, are described in the text. The core is a Ferroxcube one, type D25/17.5/11.5//111$_b$.

On the contrary, it is very helpful as an indicator that it IS working, because these counts are produced by cosmic radiation, which comes from outer space, and, because of its high energy, penetrates our atmosphere very easily, and is detected by the Geiger tube. If, when the gear is turned on, no counts are heard at all, it is a fair presumption that something is not working properly. Usually, it merely indicates that the batteries have run down a little, and that, as a result, the voltage applied to the Geiger tube needs increasing a little by way of compensation.

PRACTICAL PROBLEMS

Having sketched something of the practical use to which the counter is put, and also a little about what it actually does, let us now turn to the design of the circuit in which the Geiger tube is used. First of all, we want to know something of the difficulties attached to producing a suitable operational instrument.

Basically, the Geiger counter is a very simple device, for all that is needed to make it work is a source of high voltage, to apply to it, and a pair of headphones. For instance, if we take an ordinary D.C. power supply, of some 420 volts or so, and with a 10 meg. resistor, in series apply it to the Geiger tube, the thing will work. This can be proved simply by connecting a pair of phones across the 10 meg. resistor, using a 0.1 μf. condenser to block the D.C. from the phones. The counts will then be heard quite clearly, if somewhat faintly. Nothing could be very much simpler than this, nor is it complicating matters very

much to imagine a simple audio amplifier acting as a buffer between the Geiger tube and the headphones, and so giving a louder signal.

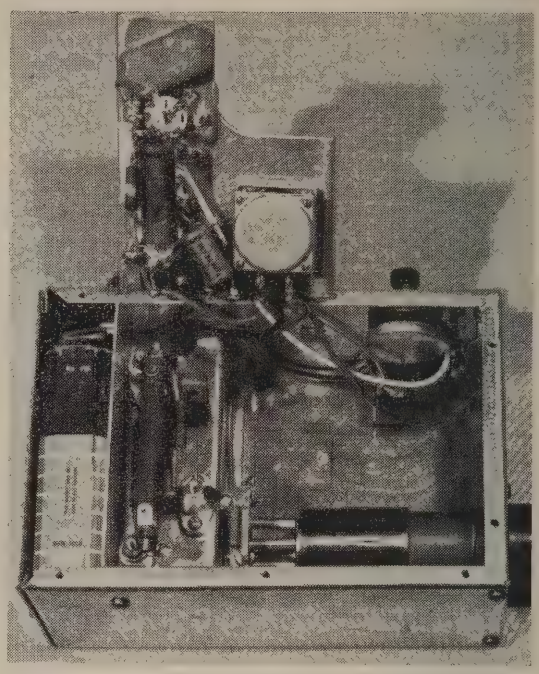
Fundamentally, then, this is all the present circuit consists of. The only real difficulty is that such a thing as a 420-volt dry battery would be rather cumbersome as part of a portable equipment, and we are thus forced to see if we cannot find some convenient means of obtaining the required high voltage from a circuit whose prime motive power is a dry battery of very much smaller voltage.

In the March, April, and May issues of our Australian contemporary, "Radio and Hobbies," a counter circuit was described which made use of the same MX103 Geiger tube as we have used here. The designer of that circuit used a method well known to television students as the "ringing choke" method of high-voltage generation, and was able to produce his total of approximately 420 volts using a B battery supply of 135 volts. Because the Geiger tube is not interested in just how it gets its voltage, the anode in the "Radio and Hobbies" circuit was connected to H.T., so that the ringing choke circuit had to produce a negative potential of only 285 volts, negative with respect to earth. Thus, when this potential was applied to the cathode, the tube floated across a total potential of 420v.

In the circuit described here, we have been able to effect a considerable improvement on these figures. Instead of a ringing choke, we have used a simple feedback oscillator circuit, which functions at approximately 10,000 c/sec. Then, by making the plate winding an auto-transformer, the voltage is stepped up considerably before being rectified. By the expedient of using a voltage-doubler rectifier, it has been found possible to obtain the required total voltage using an H.T. battery for the oscillator valve, of only 45 volts. This means a saving of two-thirds the weight of the H.T. battery used in the "Radio and Hobbies" circuit. Nor is this saving effected by dint of increased current drain. In our case, this is actually slightly lower than quoted for the other equipment, so that there is a saving of just over two-thirds the B battery power. This means that, with the present design, three Minimax 45-volt radio batteries will last three times as long as they would in the other circuit. The A battery drain has been reduced to 75 ma., so that a single set of batteries can be expected to last a very long time in service.

THE CIRCUIT

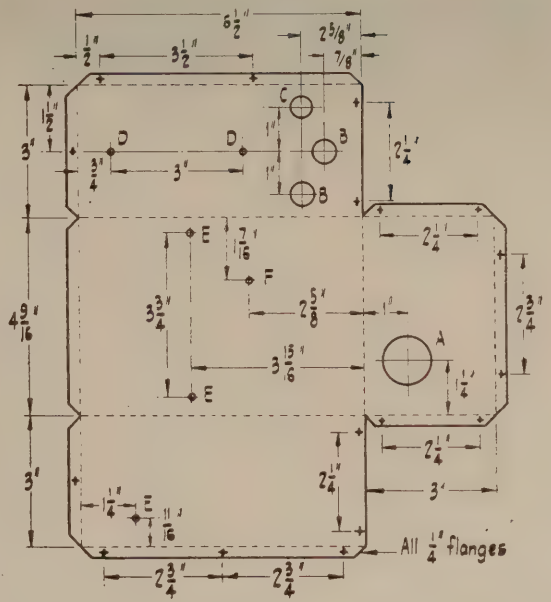
The circuit uses only two valves and one metal rectifier, apart from the Geiger tube itself. The first of these is a triode-connected DL96, and its circuit is that of a straightforward tickler feedback oscillator. The coils are wound on a Ferroxcube pot-type core, and there is a step-down from the plate winding of 144 turns to the grid winding of 72 turns. The 650-turn winding is merely a continuation of the plate winding, and with it acts in auto-transformer fashion to step up the oscillation voltage before it is applied to the rectifier circuit. The plate voltage on the oscillator is variable by means of a 50k. rheostat in series with the supply voltage. This is an economy measure, because, with a fresh B battery, the required voltage is generated with less than the maximum available 45 volts. Thus, running the voltage down slightly by means of a series resistor enables the voltage to be obtained at a slightly reduced H.T. current. The saving is only about 0.2 ma., but out of a maximum total of 1.2 ma. this is a saving of some 16 per cent., and so is very well worth while.



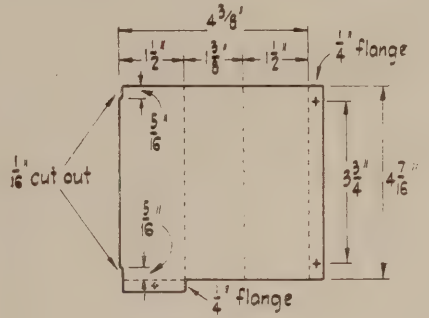
This photograph shows how the sub-chassis may be lifted out without disconnecting any leads. The transformer, and the cut-out through which the Geiger tube passes can be seen in this view.

The output voltage of the oscillator is rectified by a voltage doubler circuit. Such a circuit requires two diodes, the first of which is the diode section of the DAF96, while the second is a metal rectifier, type 16HT20. A valve rectifier in this position would have been preferable from one point of view, because it would have enabled a greater output voltage to be obtained, on account of its higher back resistance. However, had a valve been used for D_2, it would have been necessary to provide for it a separate A battery, which, in addition, would have had to be insulated from the chassis, as it would be some 200 volts negative with respect to the chassis. It would also have required a separate switch, so that the arrangement would hardly have been a practical one.

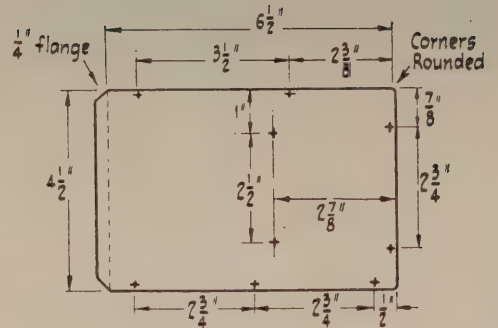
To avoid all these difficulties, the metal rectifier is used, and we have to put up with the fact that in this application it is somewhat less efficient than the valve rectifier would be. The E.H.T. voltage thus generated is negative in polarity, and is applied through a 10 meg. load resistor to the cathode of the Geiger tube. The anode of the Geiger tube is connected directly to B+, so that the 45 volts is effectively added to that produced by the rectifier system. The audio amplifier is quite ordinary, except that the pentode section of the DAF96 is triode-connected. This is done in order to provide a better match to the impedance of a pair of ordinary 2000-ohm headphones than would be obtained if the tube were pentode connected. The question of voltage gain hardly arises, since the pulses produced by the Geiger tube have an amplitude of almost 400 volts! The audio stage is self-biased by the grid-leak method,



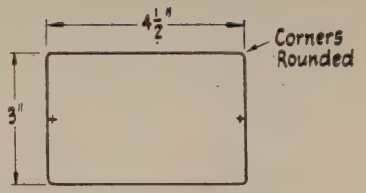
ITEM ① Drillings:
A = 1 5/32" Dia. B = ½" Dia. C = 7/16" Dia
D = ⅛" Dia. holes for 3" Chrome handle.
E = Mounting holes for Item ④
F = Mounting hole for Item ⑤
+ = Centres for ¼" Self Tapping Screws



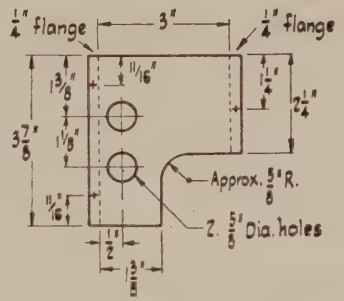
ITEM ④
+ = Centres for ¼" Self Tapping Screws



ITEM ②
+ = Centres for ¼" Self Tapping Screws



ITEM ③
+ = Centres for ¼" Self Tapping Screws



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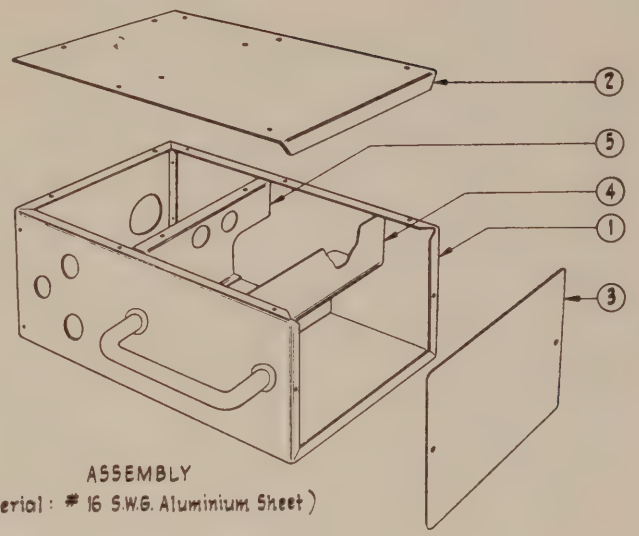


ASSEMBLY
(Material : # 16 S.W.G. Aluminium Sheet)

and a 250 $\mu\mu$f. condenser is connected from grid to ground to bypass some of the oscillator frequency which might otherwise be too loud for comfort. It does this with little or no effect on the loudness of the pulses in the headphones.

When the Geiger tube conducts, the pulse applied to the DAF96 is negative in polarity, and so causes this tube to be momentarily cut off. For this reason, the plate current of this stage could be taken as a measure (in a rough sort of way) of the counting rate. To do this it would only be necessary to insert a sensitive meter in series with the plate-load resistor of the tube. The greatest counting rate would then be indicated by the smallest plate current. Unfortunately, the meter would need to be quite a sensitive one, reading 100 micro-amps full scale, because the normal plate current of the audio stage is only of this order in the absence of signals, and becomes smaller still as the counting rate increases. It was for this reason that a meter indication was not incorporated in the completed instrument. It would have been quite a simple matter to work a relatively insensitive meter from a second amplifier tube, but the advantages conferred were thought not to be worth the increased current drain that would be involved. It is true that the additional stage would normally pass little or no plate current except at high counting rates, but, even so, the additional A battery drain would have to be reckoned with.

CONSTRUCTION

The construction of the instrument is well illustrated by the photographs and by the drawings showing how the metal-work is made. The phone jack, the variable resistor, and the double-pole on/off switch are mounted on the top of the main box, and all other components are mounted either on the sub-chassis which holds the valves and most of the wiring, or on the partition of the battery compartment. The only things mounted on the latter are the metal rectifier and the filter circuit which follows it in the circuit, comprising the 0.001 condenser, the 2.2 meg. resistor, and the 0.05 μf. condenser. The socket for the Geiger tube is also mounted on the battery compartment partition, and a piece is cut out of the corner of the main chassis to allow the tube to pass through. To change tubes, the side of the box is removed and the single fixing screw for the chassis is taken out. This enables the chassis to be moved back slightly towards the batteries, and in turn this allows space for the valve shields to be removed and the valves unplugged. After changing valves, the same procedure is followed in reverse order, and the side of the case is replaced.

SHIELD FOR THE GEIGER TUBE

It is necessary, for two reasons, to place a metal shield round the Geiger tube, or rather round that part of it which projects from the case. This, of course, is the "business end" of the whole instrument, and is brought near, or placed in contact with, the specimen to be tested for radioactivity. In the first place, the metal shell of the tube is the cathode, and therefore has a potential of some 380 volts on it. If this should be short-circuited, no harm could occur, as the supply can only deliver a small fraction of a milliamp of current and because its regulation is very poor. However, it would prevent the tube from working. Also, the tube is a reasonably delicate thing, and should be protected from direct mechanical shock. Thus, a thin-walled brass tube has been mounted as an extension to the case of the instrument, to act as a cover for the tube. The latter is insulated with a piece of celluloid or polythene sheet, wrapped once round it, before the cover is screwed in.

The cover is made from a piece of thin-walled brass tubing (20 gauge) of 1¼ in. outside diameter. It is held in place by soldering it to the flange portion of a flange-mounting bayonet electric-lamp socket. The original screw holes are used for mounting, with three self-tapping screws. To change the Geiger tube, the cover is removed and the tube pulled straight out.

AVAILABILITY OF TUBES

We have been informed by the stockists of the Geiger tubes that the supplies which they had hoped to have available before now were held up in the United Kingdom, and are not expected to arrive much before Christmas. However, in spite of the fact that those who wish to build this counter circuit will not be able to procure the Geiger tube immediately this article is published, we have decided not to hold up publication of the latter. The idea is that builders can easily get the remainder of the works built and have it ready to plug the counter tube into as soon as it is available.

TESTING

Unfortunately, the only way of testing the circuit, as built, is to try it, with the tube plugged in, and see if it works. This may sound silly, but in reality it is not. Those with a vacuum tube voltmeter can test the oscillator circuit and make sure it is functioning, as can those who have an oscilloscope handy. Both these instruments will enable one to test the oscillator and to measure the R.M.S. output voltage at the plate. It is almost impossible, however, to measure the D.C. voltage produced by the rectifier circuit. The reason for this is that, under operating conditions, there is no D.C. load at all on the output of the rectifier system. Putting even a high-impedance V.T. voltmeter across the output will alter the voltage, so that a true reading is not obtained. The only sort of instrument that will give a true reading under these conditions is an electrostatic voltmeter, because it draws no current at all from a D.C. supply. Thus, provided that the oscillator can be proved to be working satisfactorily, the final test is simply to insert the Geiger tube and switch on. The control rheostat is set at maximum resistance, and is gradually rotated. Quite suddenly, counts will begin to make themselves heard. The control can then be advanced a trifle and the instrument is all set to detect radiation.

ANNOUNCEMENT

P. R. MALLORY & CO. INC., of Indianapolis, Indiana, U.S.A., have formed in Australia a wholly-owned subsidiary, P. R. MALLORY & CO. PTY. LIMITED, for the purpose of the latter Company engaging in Australia and New Zealand in the manufacture, promotion, and sale of "MALLORY" products and materials.

The Directors of the new Mallory Australian Company are:
PHILIP R. MALLORY, Chairman, of the Board of P. R. Mallory and Co. Inc.
JOSEPH E. CAIN, President, P. R. Mallory and Co. Inc
CLIFFORD S. GITTOES, Managing Director, Ducon Condenser Limited.
JAMES OGILVY, Director, Ducon Condenser Limited.
RUSSELL W. R. WILTSHIRE, Assistant Manager, Ducon Condenser Limited.

P. R. MALLORY AND CO. PTY. LIMITED (Australia) have acquired 136,000 fully-paid 10/- Ordinary Shares in DUCON CONDENSER LIMITED of Sydney at a premium of 2/3 per share. (This shareholding represents 25% of the Issued Ordinary Capital).

Under the agreement, DUCON CONDENSER LIMITED secures the exclusive rights for the sale and promotion in Australia and New Zealand of "MALLORY" products, and also acquires the manufacturing rights, technical data, and know-how in respect of "MALLORY" Capacitors, Resistors, Potentiometers, Timer Switches, Television Tuners, and other Electronic products, including those which will be developed in the future.

The Agreement with the "MALLORY" organization will be implemented in New Zealand by DUCON (N.Z.) LIMITED of Wellington, a subsidiary of DUCON CONDENSER LTD., Australia.

This new relationship of MALLORY with the DUCON organization comes at a time when considerable activity is expected in Australia and New Zealand in preparation for the introduction of Television. Significant, too, are the benefits that will be derived under the agreement, from the point of view of electronic equipment for defence purposes.

The New Zealand Company has recently purchased and is in the process of removing to a 18,000 ft. building in Wright Street, Wellington.

DUCON (N.Z.) LTD. WELLINGTON

DUCON Capacitors

Works: 26 Wright Street, Telephone 52-905. Office: 21 Grey Street, P.O. Box 630, Telephone 42-411.

Circuits for the Experimenter

A High-voltage Power Supply for Oscilloscopes

When one is building an oscilloscope, or just experimenting with cathode ray tube circuits, a source of high voltage, of anything from 1,000 to 5,000 volts will be required, and it is unfortunately true that many experimenters are put off from playing with the C.R.T.s by this very fact. The easiest way of obtaining the voltage is by the time-honoured method of rectification from a special high-voltage transformer, direct from the 50 cycle mains. While simple in theory and practice, this method has several disadvantages. First, it is expensive. The E.H.T. transformer is costly, especially if the voltage is over 2500, but that is not all. A special rectifier valve must be used, and if the oscilloscope is not to have its picture spoilt by hum, good filtering must be undertaken. The drain from the transformer is quite small—generally much less than 1 ma., so that smoothing condensers of the order of 0.25 μf. are required, and this is just as well, because high-voltage smoothing condensers are expensive items. All told ,then, the expense of the direct 50 cycle mains supply for such high voltages can act as a very effective deterrent to the would-be experimenter or even to the technician or engineer who really needs a 'scope.

The best-known alternative is to use an R.F. oscillator to generate a high voltage, which is rectified in the usual way. This scheme has several advantages. First, the high-voltage mains transformer is eliminated. The D.C. output voltage still has to be smoothed, but as the frequency is usually between 50 and 100 kilocycles per second, only very low capacities are needed in the smoothing filter, which is therefore much less expensive. In particular, there is a very useful line in porcelain-cased high-voltage mica condensers currently available from war surplus sources, at very reasonable prices. Another advantage is that the supply is much safer. It is possible, of course, to obtain a shock from it, but not a lethal one. The reason for this is that the regulation is very poor. In other words, so little energy is stored in the smoothing condenser that the voltage drops immediately any substantial load is placed on the supply, and a dangerous shock is not possible.

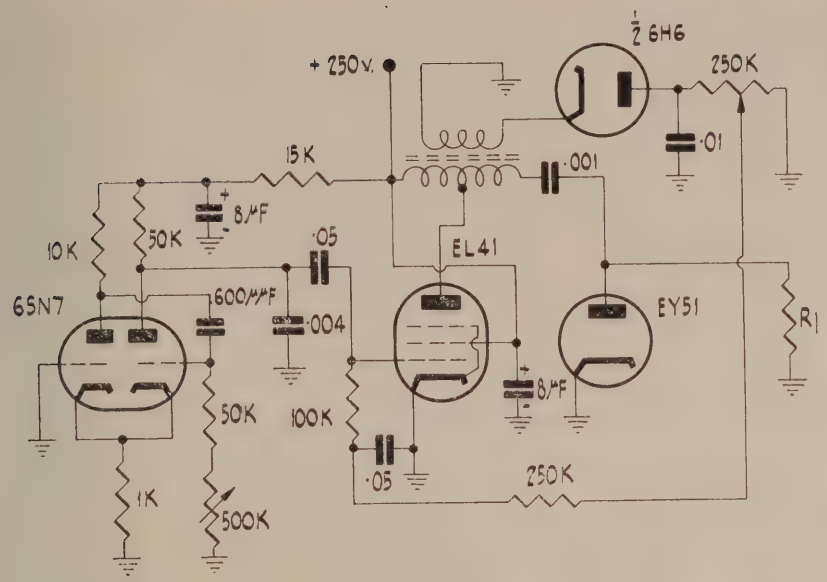
The main disadvantage of the R.F. power supply is that it is not very easy to obtain satisfactory results from it unless a specially designed and made R.F. transformer is used in the oscillator circuit. In addition, different coils would be needed for obtaining lower or higher voltages, and these would necessitate a complete re-design of the circuit. It is thus not a very satisfactory solution for the home experimenter, in spite of its obvious advantages, not the least of which is that the high voltage is obtained from a D.C. oscillator power supply of only 250 or 300 volts. The R.F. supply is therefore admirably suited to use in portable instruments which must be operated from a vibrator supply, with an accumulator as the primary source of power.

THE RINGING CHOKE METHOD

Fortunately, however, there is a third method which can be used, and this has all the advantages of the R.F. power supply, without its disadvantages. Basically, it is the method used in almost all present-day television receivers, in which the high voltage must be 8,000 volts or higher. Indeed this method is used without undue difficulty for generating D.C. voltages as high as 20 KV. Consequently, we can expect it to be very easily applied to the production of voltages in the range from 1 to 5 kV. The frequency to be removed by the smoothing filter is a good deal lower than 50 kc/sec., as with the R.F. power supply, but as we shall see, it is still high enough to make power supply ripple no problem, and to enable quite low capacity condensers to be used. Consequently, the cheapness of the smoothing filter still holds, as does the advantage that the power supply ripple is high in frequency, and very easy to filter. The safety factor of the ringing choke supply is as good as that of the R.F. one, and for the same reason. Further, the output voltage is very easily adjusted without any basic change in the design of the circuit. In addition, too, a simple form of voltage regulation can be applied with very little effort, and this improves the regulation of the supply under working conditions, without making it good enough to introduce a lethal shock hazard.

No doubt many of our readers are familiar with this method of generating high voltages, but there must also be quite a number who have not heard of it, and who will want to know how it works.

It is based on the principle that if a current through an inductance is suddenly interrupted, a very high back E.M.F. is generated. By **back** E.M.F. is meant that its polarity is opposite to the voltage drop in the inductor before the current is interrupted. For example, suppose we pass the plate current of a valve through the inductor (or choke), and suddenly interrupt it by momentarily taking the grid of the valve below the voltage required to cut off the plate current. Just prior to our cutting off the valve, there must have been a current flowing from the H.T. line, through the choke, to the plate, and thence through the valve to ground and back to the power supply. The plate end of the choke must therefore have been negative in potential with respect to the H.T. line. Therefore, when the current is suddenly broken, the high back E.M.F. is in such a direction as to make the plate end of the choke positive with respect to the H.T. end. We therefore have a large positive pulse generated, and it is a simple matter so to organize the circuit conditions that this pulse is several thousands of volts in amplitude, even though the plate supply for the valve is not more than 250 volts. This, then, is the basic idea used in the ringing choke high-voltage generator. That it actually happens, and is in reality more than just an idea, will be vouched for by anyone who has not been careful enough while testing the windings of a high-quality audio transformer for continuity with an ohm-meter! When doing this, be sure to avoid holding one test lead in one hand, and the transformer lead in the other while breaking the circuit. Even 1 ma. flowing in an inductance of several hundred henries can generate a voltage pluse



Circuit of the E.H.T. supply. The transformer and its construction is completely detailed in the text of the article. The load, represented by R_1 on the diagram, will in practice be the voltage divider from which the various electrodes of the C.R.T. are fed. For this sort of supply, it should have a total resistance of approximately 10 Megohms. This is somewhat higher than is usually specified when the supply is from the A.C. mains, but the right values can easily be obtained by multiplying all the resistances in the recommended chain by a factor which will make the total restistance equal to the desired 10 Megs.

of some thousands of volts if the circuit is suddenly broken.

However this may be, it still hardly explains how the method is made to produce a steady voltage equal to that of the very short pulse we have described. Luckily, the answer to this is a very simple one. It is only necessary to make the process repetitive. If this is done, we then have hundreds of high-voltage pulses every second (or even thousands if we like) and thus our single pulse has become an alternating current waveform, which can be rectified, even if it does not resemble a sine-wave in the slightest, and then smoothed, to produce a well-filtered D.C. output voltage. Needless to say, making the process repetitive in this way calls for some automatic method of allowing the valve to pass current and then become rapidly cut off, but there is no difficulty in devising a means of doing this. In the circuit about to be described, it is accomplished by using a second valve to generate a saw-tooth waveform of relatively high amplitude. This waveform is then applied to the grid of the valve in whose plate circuit the choke has been connected. If the saw-tooth is a positive-going one, the grid voltage rises slowly, until the valve is passing a quite high plate current, then, the "flyback" of the saw-tooth happens, cutting off the plate current very suddenly, and causing an output pulse. Immediately following the flyback, the linear rise of the saw-tooth recommences, and at the end of it, a further pulse is made. This action goes on continuously, at a frequency which is obviously determined by the frequency of the saw-tooth generator. However, there is a little more to it than this. If the saw-tooth is considerably larger in amplitude than the cut-off voltage of the valve to which it is fed, and if the latter is biased well beyond cut-off, it will pass plate current only during the positive portion of the saw-tooth. Now the valve current may rise momentarily to as much as 100 ma. if the saw-tooth takes the tube almost into grid current, so that we have a nice large current to be broken. But seeing the valve is working under much the same conditions as a Class C amplifier, the **average,** or in other words, the D.C. plate current will be only a small fraction of the 100 ma. In other words, the peak current, which is what counts when it comes to making a high-voltage pulse, is large, but at the same time the average current, which is what the H.T. supply has to deliver, is low. The net result is a very high overall efficiency. As an actual example, 10 to 15 ma., at 250 volts (the H.T. demand of the pulsing valve) is not a very high price to pay for obtaining 3,000v. at 0.3 to 0.5 ma. This represents an efficiency of only about 40%, but the remainder of the energy is dissipated as heat in the valve, and losses in the choke and in the rectifier valve. Indeed, the H.T. requirement can easily be met by the same power supply which is built into the 'scope for the benefit of the time-base and amplifier circuits. We thus build our oscilloscope with only a single power supply, and a low-voltage one at that in most cases.

Another very important advantage of the system is that unlike the R.F. power supply, its output is very readily adjusted, either manually or automatically. It is only necessary to vary the H.T. voltage to the whole circuit, or the bias on the pulsing tube, or the amplitude of the saw-tooth fed to its grid, to effect very smooth control.

WHAT ABOUT THE "RINGING"?

So far, our explanation has not explained the "ringing" part of the title, which comes about in this way. The choke is notable mainly for its inductance, which is the property of which we make use in producing the high-voltage pulse that has been discussed. Unfortunately, though, the windings have a certain amount of stray, or distributed capacity, which is there whether we like it or not. This means the choke is really a tuned circuit, whose resonant frequency is several times higher than that of the saw-tooth driving voltage. Because of this, the output at the plate of the pulsing tube is not just a single pulse. It is a damped oscillation at a frequency of some 20 kc/sec., or higher, depending on the design of the choke. It is this damped

oscillation that gives the name of "ringing choke" to the arrangement. In actual practice, the choke continues to ring usually until the valve starts to pass current again, when the plate resistance of the valve damps the circuit so heavily that the oscillation stops forthwith.

PRACTICAL CIRCUIT

The complete practical circuit is shown in Fig. 1. A 6SN7 is used as a cathode-coupled multivibrator type of saw-tooth generator. Other double triodes may be used in the same circuit, provided that the cathode resistor is adjusted to suit. The circuit will not oscillate if the cathode resistor is either too large or too small, but the value is not critical, and provided the oscillator never fails to start, there will not usually be any reason for changing it. For instance, the same values are quite satisfactory for a 6J6, whose characteristics are very different from those of the 6SN7. If it were not for the 0.004 μf. condenser to earth from the right-hand plate of the oscillator valve, the output would be negative-going pulses at the same frequency as the saw-tooth, and high-voltage output would still be obtained from the circuit, but at much reduced efficiency, because the pulsing tube would then be conducting all the time, except for the duration of the negative pulses, which are very short. Under these conditions, the life of the following valve would be very short.

An EL41 was chosen for the ringing choke tube because of its high mutual conductance, and short grid-base, as well as because it can supply large peak currents very easily. Other high-Gm. output pentodes such as the KT61 or EL33 could be used equally well, but others, like the 6V6 which have much higher cut-off voltages, would give much smaller efficiency unless the saw-tooth amplitude were increased. The 15K. dropping resistor and 8 μf. bypass condenser have two purposes. One is to limit the current drawn by the 6SN7, and the other is to reduce the saw-tooth output voltage of this tube to more manageable proportions, as there is no point in having too high an input voltage for the EL41.

In the plate circuit of the EL41 we have not the "choke," but rather an auto-transformer, with a small subsidiary winding, whose purpose is to provide an automatic control voltage. The auto-transformer trick is not indulged in for fun, or just to make the circuit a little more complicated. It is there in order to lengthen the life of the EL41. Supposing we do away with that part of the primary winding between the plate of the EL41 and the rectifier. It would still be possible to make the circuit produce up to 5,000 volts or so, by re-designing the rest of the circuit, but if this were done, the whole of this voltage would be applied to the plate of the valve, which after all is rated for a plate voltage (while passing no plate current) of only 500 volts. There would thus be some danger of the tube arcing over. In order to gain a little insight into the working of the circuit, it should be stated that the voltage actually generated is directly proportional (a) to the inductance of the choke and (b) to the current passing through it at the moment of the break. Thus, if we tap the plate of the valve down the choke, as shown, we use only a fraction of the inductance directly in the plate circuit, and this must be compensated by using proportionately more peak current. This is no hardship, because the remainder of the winding then acts as an auto-transformer, so that we still obtain the required pulse voltage, but what we have done is to decrease the portion of it to be found at the plate of the valve. In the actual circuit, the plate portion of the winding consisted of 250 turns, while the remainder was 500 turns. Thus, only a third of the developed pulse voltage is found at the plate, and this will therefore be only 1,000v., when the output voltage is 3,000 and 1,600v. if the output is run up to 5,000. This is still much higher than the official ratings allow, but we are saved by the fact that the duration of this excess voltage is very short. Flash-over is a function not only of the voltage present, but also of the time for which it exists, so that we are helped out by the pulsating nature of the output voltage.

The 500k. variable resistor in the grid circuit of the 6SN7 is a frequency control, and enables the most efficient operating condition to be found. If desired, a fixed resistor can be substituted for it after the circuit has been put into operation. It is adjusted until maximum output voltage is obtained, and is then left at that. If the circuit is in actual use in a 'scope circuit, maximum voltage can be recognized as the point where a given voltage on the deflection plates produces the **least** deflection, since the deflection is less sensitive the higher the final anode voltage. Otherwise, a 0-1 ma. meter can be connected in series with a 10 Meg. resistor and placed in the position of R_1 on the diagram, providing a D.C. load for the rectifier. If the resistor is accurately known, this gives a simple method of actually measuring the output voltage.

The secondary winding on the "choke" is a small one of only 16 turns, which never-the-less gives a peak output of some 64 volts. This is applied to one half of a 6H6 or similar tube so as to provide a negative D.C. output, a portion of which is applied as bias to the EL41 grid circuit. The 250k. potentiometer forms a pre-set control of the ouput voltage of the supply, and the automatic bias regulates it against line voltage changes or changes of load, as occur when the brilliance of the 'scope tube is turned up or down.

CONSTRUCTION

There is only one special component needed for the circuit, and that is obviously the pulsing transformer. It is wound on a special Ferroxcube core, which is in the shape of a pair of Es. These are butted together to form a core of the shape used in conventional power and audio transformers. The maker's type number for this core is E-41/22/9. It can be bought bare, or complete with a suitable rectangular-section bobbin, specially made for it. To make the transformer, the core and its bobbin are required, together with the following materials.

(1) Some 40 S.W.G. enamelled copper wire.

(2) Some alkathene sheet, for insulation, 0.012 in. thick, or close to it. The exact thickness does not matter, because the bobbin is not filled right up when the windings are complete.

First of all, end pieces are made from the alkathene, and are cut through in one place to enable them to be slipped over the bobbin, thus making insulating end cheeks inside the end cheeks of the bobbin. Before starting winding, a single layer of the

alkathene is put on round the bobbin, and is held in place by the first layer of wire. The first winding to be put on is the 250 turn one which is connected between H.T. and the EL41 plate. It is wound in five layers of 50 turns each, as close as possible to one end of the bobbin. This leaves space beside it for the 500 turn winding, which is put on similarly, but with 100 turns per layer. This method leaves a space of just under one eighth of an inch between the inner ends of the widings. Make sure to wind both windings in the same direction. Then, the start of the 250-turn winding is terminated on the cheek at which it starts, and the finish of the same winding is connected to the start of the 500-turn winding, and the lead is brought over the top of the 250-turn winding and terminated in another of the slots provided in the same cheek as was used for the start of the 250-turn winding. The finish of the 500-turn winding is then terminated on the opposite cheek, thus giving the greatest possible separation of the high-voltage leads. When these two windings are completed, they will be of the same height, so that a full-width wrapping of the alkathene can be put over both of them. Two layers should be put on, and tied in position with thread.

Over the top of the insulation is put the 16-turn winding, and its ends are terminated in the cheek slots as far as possible from the high-voltage windings termination.

It does not matter much which end of the small winding is earthed when the circuit is wired up, but preferably, wind it in the same direction as the other two windings, and make the start the earthed end. The main constructional difficulty will be preserving the insulation in the wiring from the transformer, which is very small. Make sure that the leads do not approach the core too closely, and that they are sheathed in P.V.C. insulation taken from some P.V.C. hook-up wire.

If desired, the transformer may be mounted in a metal can which can be purchased specially for it. This can is seamless, and is provided with a tinned metal base, with provision for soldering in small glass-insulated feed-through leads. If the transformer is potted in this way, and filled with tranformer oil before the last hole in the base is soldered up, the job should last forever. If you do not wish to go to the expense of buying the can and its associated hardware, the core can be mounted by making slots in two pieces of insulating fibre so that the ends of the core are a neat fit in the slots. Then, angle-brackets can be attached to the fibre mounting boards, to enable them to be screwed to the chassis in a vertical position.

IMPORTANT

When putting the transformer together, after winding, make sure that a 0.002 in. gap is allowed by sandwiching two thicknesses of cigarette paper between the halves of the core.

NOTES FROM THE N.Z.A.R.T.

(Supplied by the Publicity Committee, N.Z.A.R.T., 25 Lees Road, Christchurch, to whom all inquiries should be addressed).

Inquiries have been received concerning the functions of the Amateur Radio Emergency Corps. It has even been said that the Corps is a "plaything of the Amateurs," but such is far from the case, and a statement of this kind can be inspired only through ignorance.

As membership of the Corps is drawn from the Association, naturally the operation of transmitting apparatus is limited to licensed amateurs. In spite of this restriction, however, there is a definite place in the Corps for the non-transmitting member. These jobs need no ennumeration, as a little thought on the part of readers will suggest many possibilities.

The Corps provides a strong nucleus of amateurs who are prepared to provide emergency communications, where they are required, when they are required. They are not paid for their services, nor do they expect payment. They realize that their reward from an emergency is the satisfaction derived from a job well done.

As with all organised traffic handling schemes some definite form of procedure is necessary and with this in mind some sections have been holding on-the-air practices. This scheme not only gives the necessary practice but assists in bringing speed and accuracy . . . a must if traffic is to be handled efficiently.

For some time CW was in use but recently there has been a swing to phone. Telephony is a faster method of communication but has the disadvantage in that adverse conditions do not treat it kindly. With this thought in mind, some time is still devoted to telegraphy.

The present OC of the Corps, W. D. Gorman ZL2IY (Doug), follows in the footsteps of very able predecessors. Doug has proved a tower of strength to the Corps and has devoted a considerable amount of his time to bring it up to the present standard.

To many, the only function of the Corps seems to be the provision of personnel and equipment at motor rallies and the like. These appearances are not official AREC stunts, but merely the result of negotiations between the sections concerned and the Sports body in question. The fact remains that stunts such as this do provide valuable practice for the section concerned and help it to meet later emergencies,

The real purpose of AREC has been demonstrated on many occasions since the cessation of hostilities. Aircraft crashes, mountain accidents, bush searches, and searches for small craft have taken members into many parts of the Dominion and have given the Corps a chance to prove itself a willing and efficient service under adverse conditions.

AREC is a member unit of the Search and Rescue Organization and as such provides trained and experienced personnel in many parts of N.Z.

Equipment mainstays are the WARB units, ZC1, 208, and a sprinkling of FS6 and 108 types. A great deal of the equipment has been purchased by the sections themselves and all maintainence costs are paid for by members. AREC can still do with more members and some Branches have still to form sections. This will come with time and soon we hope to say . . . "AREC covers the Dominion."

May we extend to all readers the best wishes of the Association for the coming festive season . . . "Merry Christmas, Happy New Year, Long may your Key Click and your phones rattle."

The PHILIPS Experimenter

No. 86: PHILIPS TRANSISTORS—Part 1

Reprints of these EXPERIMENTER articles, complete with illustrations, will be mailed to any address for one year for a subscription of 5s. Application should be made to Technical Publications Department, Philips Electrical Industries of New Zealand Ltd., P.O. Box 2097, Wellington.

INTRODUCTION

There is little doubt that the outstanding thing in post-war electronics has been the invention and subsequent development of the semi-conductor triode, or transistor. Full credit must go to the pioneering work of the Bell Telephone Laboratories, and to other industrial laboratories in the United States, which have realised the tremendous potential importance of transistors to the electronic industries of the whole world, and have put an enormous amount of work into bringing transistors out of the laboratory and into actual field application, in the shortest possible time.

At the same time we are proud to be able to say that the Philips laboratories in Eindhoven have been equally alive to the possibilities of the transistor, and in the short time that has elapsed since the first data were published in America, have concentrated a great deal of effort on the same problems as have been exercising the best engineering brains in other countries. The work carried out by the Philips organization has borne excellent fruit, so that at the time of writing, Philips is able to offer two point-contact, and two junction type transistors, all of which are in quantity production, and whose characteristics are not excelled even by those turned out in the home of the transistor, America.

The manfacture of transistors on a production basis is a vastly different thing from producing them experimentally in a laboratory, and it has been Philips's wide experience in the technique of ordinary valve making, as well as their almost unrivalled facilities for research and development work that have enabled a number of very difficult technilogical problems to be overcome. When it is realized that the success or otherwise of a transistor manufacturing process depends on controlling the composition of metallic germanium to an accuracy of a few parts in a million, even before one tackles the problem of handling and mounting such material without contaminating it, and before the question of spacing two "cat's whiskers" by almost unbelievably close tolerances is overcome, (to mention only two of the practical difficulties) one begins to realize that without wide experience in the accurate manipulation of minute glass and metal parts, and without the"know-how" that Philips laboratories and factories have accumulated over a long period, making a satisfactory range of transistors would be well-nigh impossible.

Initially, a great real of work had to be done by way of investigation of manufacturing processes, before it became possible to make transistors whose characteristics were as accurately specified as are those of a conventional radio valve. This is perhaps the most important problem of all, because however great the potential advantages of the transistor may be, it is of little use to anyone wanting to use it in mass-produced equipment unless its characteristics can be relied upon to approximate to the published curves to a known degree of accuracy. The Philips OC70 and OC71 junction transistors have been designed specifically for use in hearing aids, and their characteristics are controlled as accurately as are those of conventional vacuum tubes. Although only four types of transistor are currently in production, new and improved types are constantly under development, and will be put into quantity production in the Philips factories as soon as it is possible to do so. The present trend, not only at Philips, but throughout the world, is to develop the junction types in the directions of greater power handling ability, and operation at higher radio frequencies. With its absence of critically-spaced contacts, the junction transistor is tending everywhere to displace the point-contact type, although at present the latter is better able to do certain jobs. However, it seems that a considerable period must elapse before the point-contact transistor is rendered obsolete, so that for the time being, both types will continue to appear in Philips catalogues. This series of articles has been designed to act as an introduction to transistors and their circuits, for those experimenters and others who are quite familiar with valves and their application, but who are progressive enough to want to enter what is really a new field of technical endeavour. We hope therefore that readers will find the series not only interesting, but useful and practical, for in the course of the articles we will have occasion to describe circuits which will find immediate application in a number of ways.

Fig. 1.—Cut-away drawing showing the construction of a Philips point-contact transistor. The metal outer case is the base contact, the bent pin is the collector, and the straight one, the emitter.

WHAT IS A TRANSISTOR?

Perhaps the first question that readers will want answered is "Just what is a transistor?" but unfortunately, this is one of the most difficult to answer. To do so properly, one should start off with an elementary treatise on what is known as the physics of the solid state, but this would probably turn out to be both boring and partially incomprehensible, so we intend for a start at least to bypass the question until after we have seen just what a transistor does.

We know, of course, that it can act as an amplifier, and that it is therefore capable of being turned into an oscillator. Granted that it will do these things, one would expect that with suitable circuits, it could be made to do any of the things that a vacuum tube will do. In practice, thus turns out to be true, within certain limits about which we will have something to say later. The question at the moment is therefore "what is there about a transistor that enables it to amplify?"

In order to answer this, let us take a look at the construction of a point-contact transistor. This is illustrated in Fig 1, and it can be seen that structurally, it is nothing more than a crystal rectifier which has two cat's whiskers instead of one. The crystal is a block of germanium, cut from a single crystal, while the whiskers are sharp points in contact with the germanium base, and spaced from each other on its surface by a few thousandths of an inch. Now each of these point contacts is no different from a crystal rectifier, if taken by itself, but their close proximity in the transistor causes an entirely new effect to make itself felt. In normal point-contact transistors, which are made using what is known as P-type germanium, the direction of easy current flow is from the point to the crystal, so that if a positive potential is applied to either point, the resistance of the contact is very low. Conversely, the resistance is very high, and the current small by comparison, if the battery voltage is reversed. This is simply a verbal description of the rectifying property of each contact. Now suppose we take a 45 volt battery, and apply it to one of the points in such a way that the positive terminal is connected to the crystal, or base, and the negative terminal is connected to the point. The resistance will be quite high, and in a typical case, a current of a little over 1ma. will flow. Next we take a second battery, this time of only a few volts, and connect it between the base and the other point in the direction of easy current flow. That is to say, with the negative terminal to the base, and the positive to the point. This may cause a current of some two milliamps to flow towards the base in the circuit of the second point contact. Now if we measure the current flowing in the circuit of the first point, we find that it is no longer just over 1ma., but has jumped to something like 5½ma. A little thought is all that is needed now to convince one that this behaviour is amplification. Just think for a moment what we have done. In the first step, we had zero current in what we have called the second point, and 1ma. or so in the first point's circuit. In the next step, we have caused a current of 2ma. to flow in the second point's circuit, and doing so has caused the first point's current to rise to 5½ma. In other words, a current change of 2ma. in one electrode has caused a current change of 4½ ma. in the other electrode, and we thus have a current amplification of $4\frac{1}{2}/2 = 2\frac{1}{4}$ times. Note too, for it is important, that the electrode which gives the large current change is biased in the non-conducting direction by its battery, but that the other electrode is biased in the conducting direction. The latter is the input electrode, or **emitter** while the former is the output electrode, or **collector**, and the crystal block is called the **base.**

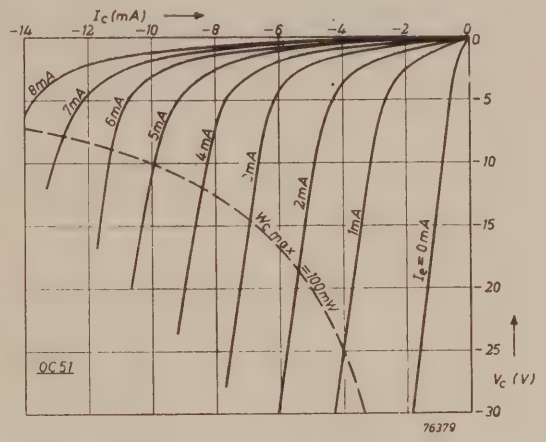


Fig. 2.—Curves of current v. collector voltage, for different values of emitter current. These are for the Philips OC51.

COMPARISON WITH VALVES

Here, too, we have our first comparison with valves. Most often, we think of a triode or pentode as a voltage amplifier, because in many practical circuits we apply the signal **voltage** to the grid (at practically no current because the input impedance is very high) and obtain a signal **voltage** from the plate current. In the transistor, we apply a signal current to the emitter and obtain an ouput current from the **collector.** In the valve circuit, the input impedance is very high—several megohms at least—and the output impedance is low by comparison. In the transistor circuit, the input impedance is only a few hundreds of ohms, but the output impedance is high in comparison, namely several thousands of ohms. Such comparisons are useful, but they should not be pushed too far, because they are not always completely valid, but they at least show that in some respects, the transistor can be regarded as the opposite of a valve. There are similarities between transistors and valves, too. For instance, both can have their behaviour described by means of families of curves. We are all familiar with the plate characteristic curves of a triode. In these, each curve shows how the plate current varies when the plate voltage is varied, with the grid voltage held constant. For a transistor, there is a family of curves for the collector current and voltage, but this time each curve is drawn for a constant **emitter current.** Here once more we see how valve terminology may be "translated" as it were into transistor nomenclature by substituting **collector** for **plate,** and **emitter current** for **grid voltage.** Such a family of collector curves is shown in Fig. 2.

If the page is turned upside down, the similarity to a set of plate curves for a triode valve is very evident. This presentation of transistor curves, upside down, as it were, is something we have to get used to, and the reason for it is worth noting. As a matter of convention, all voltages are measured with respect to the base, and since the collector must have negative voltage on it (with respect to the base) the voltage axis of the graph is drawn downwards from the origin or zero point of the graph. The remaining convention is that current flowing from one of the points to the base is called positive. Thus, in our case, the collector current also is negative, and is therefore drawn to the left of the origin.

Another point before we finish this month's technicalities. You will remember that when we increased the emitter current, the collector current increased also, but this increase is in the negative direction. It follows from this that the transistor connected in this way does not cause a reversal in phase of the signal.

A PRACTICAL CIRCUIT

Finally, so as to leave readers with a practical circuit, here is an example of the extreme simplicity of some transistor arrangements. The circuit of Fig. 3 shows a transistor relaxation oscillator, which will generate both a pulse and a saw-tooth at the same time. It corresponds in function to a multivibrator circuit using two valves, four resistors and two condensers, and produces pulses of about 12 volts peak-to-peak amplitude. Its output can be fed through a small condenser to the aerial terminal of a radio receiver, and harmonics of the oscillation frequency will be plentiful enough to be heard all over the dial. In this way it can be used for aligning the

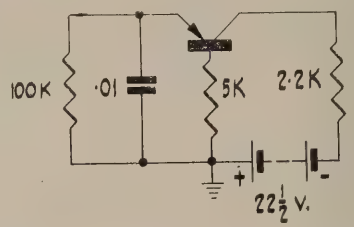


Fig. 3.—Circuit of a relaxation oscillator using a Philips OC51. This shows the standard symbol for a transmitter. The heavy line is the base, the contact with the arrow head is the emitter, and the other is the collector. In this circuit, ouput can be taken either from the base or the collector, via a blocking condenser.

trimmers and padder of a broadcast set without having to "rock" the tuning at the low-frequency end in order to find the best setting for the padder. It could be built definitely pocket size, using a hearing-aid battery, and would make a useful adjunct to a servicemen's equipment. With the values shown, the frequency is approximately 2,500 c/sec. It is possible to make the same circuit work with lower operating voltage, but in that case different values must be used.

(To be continued).

Home Appliances Exhibition at A. and P. Show

A very fine Exhibition of Radio and Home Appliances was given by G. A. Wooller and Co. Ltd. at the Auckland A. and P. Show at the end of November. The exhibition was compact and entirely self contained, being the only trade organization to be included in the show.

The G. A. Wooller Company has travelled far since its inception in 1945 as distributors of Pacific and Regent Radios and Radiograms. The Pacific and Regent models were well to the fore on the display stands as was also the new brand, Clipper, which has gained such amazing popularity in the last few months. There is no doubt that this brand is set to be one of the big names in radio in New Zealand in the years ahead.

Quite a large portion of the display area was given to home appliances, not the least of these being the Crosley "Shelvador" refrigerator. This outstanding de luxe refrigerator, designed in America, is now being manufactured in New Zealand. Before long we shall be seeing new models in this refrigerator "par excellence." While on the question of refrigeration we should mention the Kirby Air-conditioners, Dehumidifiers and Water Coolers that were on display. This is a somewhat new market in New Zealand, but, as in other parts of the world, it is one that is definitely on the increase.

Other products at the exhibition included the American Whirlpool Washing Machine, Flyer Tricycles, Merivac Vacuum Cleaners and Festival records—a fine array and much appreciated by show visitors.

Demonstrations of the Sunbeam Automatic Cooker Deep Fryer and Sunbeam Mixmaster were given by Miss Clare Collins the noted Australasian home economist. Miss Collins was spending a fortnight in Auckland demonstrating at the Show and the various big stores the versatility of the deep fryer, an American appliance which is just being released to the New Zealand public. Dealers who have seen this new appliance demonstrated predict a very great future for it.

As a trade exhibition the Show put on by G. A. Wooller and Co. Ltd., was a great success and will have been most helpful to retailers and show visitors alike. P.B.A.

ANNUAL REPORT OF PYE LIMITED OF CAMBRIDGE

We have recently received from Pye Limited of Cambridge, England, their Annual Report and Balance Sheet for the past year. So striking a document is this that it seems to us to be not only a story of the development of a great business, but an exemplar of enterprise and one of the romances of the Radio and Electronics Industries. The illuminating balance sheet figures speak for themselves. The Directors' report thereon and candid commentaries deserve the consideration of all company Directors and Shareholders.

"Our Accounts," "Colour Television," "Legal Larcency," "Pay up and be damned," Directors," are based on the feeling and frustrating experiences surrounding the development of an industry which has come to the forefront within the last quarter of a century. What seems to us to be more important, however, is that, despite the conservativeness of bankers, wars, obstruction in high places, muddled thinking in diverse directions, courage and audacity in the Pye Boardroom shine as a strong beacon light and evidence what determination and foresight can achieve in building up a great industry from small and ambitious beginnings.

RECORD TALK

By JOHN GRAY

New records continue pouring on to the market, in three speeds and as many sizes. Festival are once again well to the fore and a further crop of "extended play" 78s includes such well known names as Georgia Gibbs, Gordon MacRae and Louis Prima. There is also a group of popular LPs culled from the American Decca catalogue among which we note Carmen Cavallaro's "Tangos for Romance" (CFR10-384), a Victor Young selection recorded under the title of "April in Paris" (CFR10-369) and a Hawaiian disc on which Dorothy Lamour is joined by Dick McIntyre's Harmony Hawaiians (CFR10-422). All these should make good Christmas presents for your friends who like to keep a supply of pleasant light music for party use, and LP is of course a boon in such cases. For a more specialized and, if you like, a superior brand of light music, it is worthwhile investigating the lighter Westminster LPs, several of which feature in the latest Festival releases. The Westminster Light Orchestra, conducted by Leslie Bridgewater, play "Folk Songs of the British Isles" on WL 3000. Bridgewater, an experienced London theatre musician, has long been renowned for stylish arrangements, and his new series under this label was actually recorded in Vienna with a handpicked group of musicians. These fresh, clean arrangements have a "new sound" quite unconnected with electronics or echo chambers. For a stronger flavour of the exotic, I can recommend the series by Antal Kocze, who is known as "The King of the Gypsies." His cafe in Vienna is recognized as the centre of authentic playing such as one might hear from the gypsy bands of Hungary and Rumania, and in pre-war days, exalted musicians such as Toscanini never failed to hear Kocze's band when they happened to be in Vienna. The intense verve and sweep of the playing has been well caught in these excellent recordings.

The range of music is, perhaps, not very wide. Possibly you would not want more than one of these highly individual discs, but one at least you should have and there is a choice of several. WL 3010 is entitled "Gypsy music encores," and WL 3013 and 3015 bear the caption "Gypsy songs and Czardas," and each contains up to half a dozen of those passionate melodies culled from the folklore of the Balkan countries.

Another light disc of decided interest is WL 3017, on which pianist Herbert Seiter gives his continental interpretations of a number of popular American tunes such as "Wunderbar," "Shiek of Araby" and "So in Love."

* * *

Westminster has brought out their version of Beethoven's ninth symphony (WAL 208, 4 sides). As in the case of the Toscanini H.M.V., the Symphony No. 1 is added as a fill-up, and the whole is under the direction of Hermann Scherchen with the Vienna State Opera Orchestra and Singakademie Choir. A Festival release of Tchaikovsky's well known Concerto in B flat minor is very interesting because the solo pianist, Emil Gilels, is one of the leading pianists of Soviet Russia, or at least one of the few to become at all well known west of the Iron Curtain. On this record he plays with the Stockholm Philharmonic under Sixten Ehrling.

For some time now, Radio Corporation of N.Z. have been quietly producing the first, and so far the only LP records actually made in New Zealand. They have now become, in addition, the first to introduce locally made 45s. These are, gratifyingly, of the newer "extended play" variety, and are by well known artists from their Capitol roster. CEP 005 contains four numbers from Kay Starr, and CEP 007 will be snapped up by adherents of the Dixieland style, containing as it does four of the most famous Dixieland standards played by Pee Wee Hunt's orchestra, who also, on a "standard" disc (if we may still refer to 78 as standard!) revive the "Charleston" coupled with "So Blue" (CP 331).

On Tanza Z229 a sonorous vocal group, identified as "The Astorians," have made a version of the haunting new ballad "My Friend," a number most people will find more tolerable than many of the other so-called "religious" songs of which we have had a surfeit of late. This one does have the virtue of straightforward sincerity. Then, amid a dearth of children's records, it is good to see a Capitol release of the story of "The Flying Mouse" as told by Don Wilson (CK 021). The "Dear John Letter," and indeed other such epistles, are given what can be termed a knock-out blow by the wicked parodist Stan Freberg on CP 334.

* * *

H.M.V. have announced a number of local pressings of current popular tunes. Frank Weir's latest success is, of course, "The Little Shoemaker" (Decca Y6605) and I think you will find equal enjoyment in its backing, "Never never land." June Valli is in sentimental mood in "I understand just how you feel" on HR 10027. You may prefer the more forthright style of Pearl Bailey (Columbia DO 70052) whose latest titles are "Hug me a hug" and the intriguing "I always shake the tree." The many thousands who saw the "Genevieve" film will perhaps recall the comedy situations more readily than Larry Adler's background music, but they should none the less be interested in his recording of the main themes on Colombia DO 3656.

Record dealers, especially those south of Cook Strait, claim they can never keep enough Jimmy Shand issue in stock. There is good news for them and their customers, as H.M.V. have diverted part of their pressing plant solely to the manufacture of these records, and up to date titles by this phenomenally popular combination should be on the shelves by the time these words appear in print.

* * * *

And so we reach the latest LP release from the H.M.V. group. The approach of Christmas lends an added interest to a number of these recordings. Handel's "Messiah," for instance. To discuss recent LP releases of our national oratorio is to provoke fierce argument these days. Adherents of the "chamber choir" approach to this hallowed masterpiece will presumably spurn the new Columbia version under Sir Malcolm Sargent with the Huddersfield-Liverpool

(Continued on page 35)

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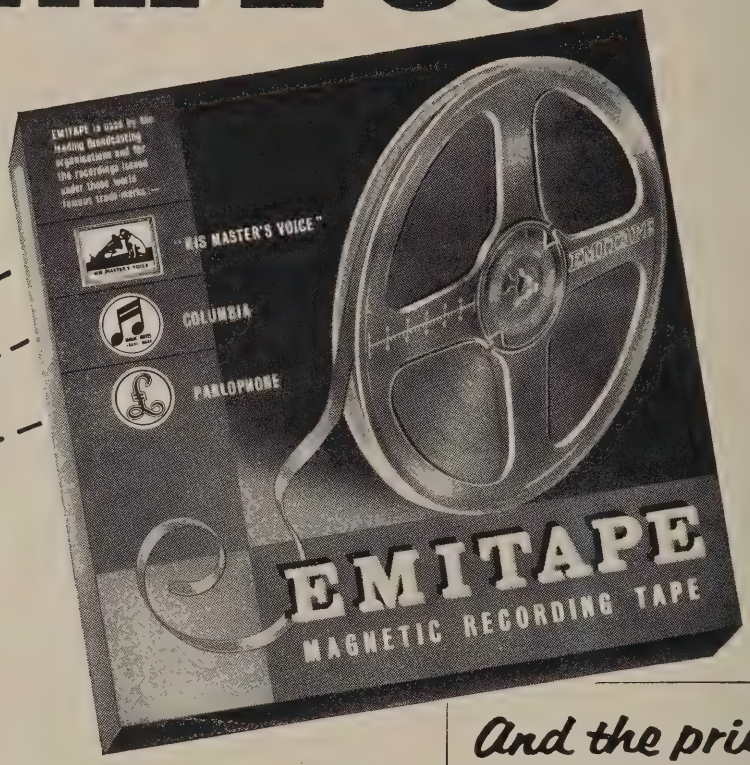

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E.M.I. now introduce a new high quality recording tape for professional or general use; the same tape in fact which is used in the studios for the initial recordings for all "His Master's Voice," Columbia and Parlophone discs, as well as for the recently released "His Master's Voice" and Columbia tape records.

Oustanding features of the new EMITAPE are high sensitivity; marked anti-static characteristic, and freedom from curl—the latter ensuring uniform and close contact with the head, and therefore uniformity in recording and reproduction. In addition, the P.V.C. base used instead of cellulose acetate gives high tensile strength (7½ lb. per ¼ in. width) and yield point (4½ lb. per ¼ in. width); very low elastic elongation (less than 0.5% at 1 lb. load, 15 secs. application) and longitudinal temperature coefficient (8 x 10^{-5} per degree F); negligible humidity expansion.

Sensitivity is considerably higher than previous tapes (9 dB above H50 tape); the print signal is at least 60 dB below the test signal after close contact for 5. minutes; the basic unweighted noise from a properly erased tape is at least 65 dB below peak recording level, and modulation noise at least 50 dB below peak modulation at 2% total harmonics.

The most important feature of all is the high degree of sensitivity uniformity achieved by the new EMITAPE. Both types—77 and 88—are manufactured under the same conditions and to the same specifications, but every reel of the 77 Emitape undergoes a special "Pen Test" examination throughout the whole length to ensure a level of sensitivity not exceeding ± ½ db. on a 1 Kc. signal, and an overall variation from reel to reel not greater than ±1 dB.

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Emitape is marketed by E.M.I. Suppliers, (Trade Division of H.M.V. (N.Z.) Ltd.,) 162-172 Wakefield Street, Phone 54-890, Wellington.

P.B.A.

Record Talk

(Continued from page 33).

forces (33CX 1146-8). This is not a transfer of the earliest set, though Norman Walker is once again the admirable bass soloist. The others are Elsie Morison, Marjorie Thomas, and Richard Lewis. There is still a big public following for what has become known, for better or worse, as the "traditional" "Messiah" performance with a large choir and orchestra, and it is doubtless for that reason this fine new set has been produced. Those who prefer smaller forces are well catered for elsewhere.

Two Christmas items are conveniently coupled on Brunswick LAT 8030. Loretta Young tells of "The Littlest Angel" and Gregory Peck is the protagonist in "Lullaby of Christmas." Those who like their seasonal melodies in up to date guise may be safely recommended to Mantovani's selection on Decca LF 1149. The other seasonal issue proceeds to the furthest possible extreme; it is a setting of the "Christmas Story" by Heinrich Schutz, the German composer who was born exactly one hundred years before Bach. This is released in the London "Oiseau Lyre" series (OL 50020) and the performance is by soloists with the choir of the Three Kings Church and the orchestra of the Collegium Musicum, of Frankfurt in Germany.

When we turn to standard music, there are discs which would make good presents for almost any kind of music lover. If your friend likes Beethoven (and you are feeling both affluent and generous) a good choice would be the composer's only opera, "Fidelio," released here for the first time on H.M.V. ALP 1130-2. Made with the forces of the Vienna State Opera under Furtwangler, this features a fine cast in some of the most inspired and inspiring music the composer ever wrote. A less expensive and equally welcome choice would be of Beethoven's sparkling second symphony recorded comparatively close at hand, by the Sydney Symphony Orchestra under Eugene Goossens (ALP 1134). For Bach fans, there is Landowska's performance of the monumental Goldberg Variations, a much newer recording than her old Society set (ALP 1139) and Brahmsians will welcome ALP 1123, whereon the veteran. Arthur Rubenstein performs the B flat major piano concerto with the Boston Symphony Orchestra under Charles Munch. Rubinstein made the very first recording ever released of this concerto, which was on H.M.V. black label records almost a quarter of a century ago—to listen to the new version is to realise the immense staying power of pianists of his school and generation.

TELECOMMUNICATIONS IN DEVELOPMENT

By DON TALON

Without the telephone, development plans falter. The VHF system is solving the physical and fiscal problems of communications.

(Reprinted from "New Commonwealth.")

One of the first snags which tripped up the many Colonial or Commonwealth development schemes in the early post-war years was the inadequacy of local communication systems. The sketchy systems in many colonies and other underdeveloped areas were designed for the benefit of administrations or confined to towns. Business men accepted bad roads and frightful telephones—or total lack of them—with fatalism. The cost of the installation of line communications in many territories was almost prohibitive; their maintenance—especially in wild or rugged areas—was almost impossible. These two difficulties—fiscal and physical—reinforced each other.

The provision of telephone communication in Colonial or undeveloped territories had, in the past, largely been based on the traditional installation of pole line routes, often through hundreds or thousands of miles of difficult country. Besides washouts due to tropical storms, they were constantly damaged by animals or overrun by the continuous growth of the jungle lining many of the routes.

But before the war there was rarely any large demand for long-distance telephone communication in Colonial areas. Communications requirements were met by the existence of simple telegraph circuits, capable of handling only a small number of telegrams per day. In many cases, communications requirements were augmented or satisfied by High Frequency radio circuits capable of handling only one telegraph or one telephone channel at a time and that of rather poor quality. But when ambitious schemes of economic development and construction were launched Governments quickly found that these inadequate facilities were holding up the work.

Their technical advisers pointed to the possibilities of Very High Frequency communications (VHF—30-300 Mc/s but about 60 to 200 Mc/s in practice). During and immediately after the war, there had been a very rapid development in such communications (which, with certain restrictions, can be utilised to provide a number of simultaneous channels over one route, at a moderate cost a channel mile). The advantages over High Frequency communications (i.e., the band 3-30 Mc/s) were considerable, because of the vastly reduced noise levels—always a problem in tropical areas—and also because of the greater stability of the communication links.

Almost equally important, it had been established that VHF was infinitely cheaper in capital cost though it is not necessarily much cheaper in maintenance except in relatively large, thinly-populated areas where the traffic is not too heavy.

Naturally, prospective customers needed assurance about the reliability of the system. Pre-war progress was held up for lack of suitable valves, but this has now been largely overcome. Indeed, many of the VHF systems in use or projected are likely to prove far more reliable than open line or H.F. radio circuits. Such VHF systems may carry up to 48 simultaneous telephone channels, although the normal requirement in Colonial areas is for 24 simultaneous channels. Any one of the telephone channels involved may carry up to 18 or 24 telegraph (teleprinter) channels. Thus a vastly increased trunk telephone capacity becomes readily available.

This new technique of radio communications is being installed in British East Africa, West Africa and Malaya. Systems are also being installed in the mining area of Northern Rhodesia and also in Southern Rhodesia, between Salisbury and Bulawayo.

The characteristics of these new systems are such that repeater stations are required every 30 or 40 miles, but from a maintenance viewpoint this is a great advantage over the older type of line system, where maintenance is required throughout the whole length of the route. Obviously it is much better, both from a security and maintenance viewpoint, to localise the equipment in a few selected spots rather than have the whole system exposed to possible interruption at a very large number of points.

The repeater stations usually consist of a reinforced concrete building and a tower. The normal tower height is 150 ft., but in hilly or difficult country 400 ft. towers may be required to ensure a satisfactory service. The radio equipment throughout the system is usually duplicated and in the event of a failure of any part of the equipment, standby equipment is automatically brought into service. This standby facility has been brought into use on so few occasions that in systems which have been installed for some years necessity may sometimes be questioned. Nevertheless, in view of the importance of absolute reliability, it is considered a worth-while precaution. Even without such duplication there is no question that radio communication systems will normally give a reliability of service far greater than that which can be obtained by open wire line systems in undeveloped territories.

The main problem with the repeater stations is that of power supply. It would be usual at the terminal stations for some mains supply to be available, but where isolated repeaters are installed it is necessary to install Diesel generator sets which are capable of giving a reliable power output without constant supervision. If all the repeater stations were attended by technical personnel the maintenance costs of the system would probably become excessive and all the equipment and stations are designed to operate on an unattended basis for periods up to 28 days.

The normal attention at the end of the 28-day period is that of refuelling and replenishing the water cooling supply for the Diesel engines. It is usual to supply two Diesel engine sets which are set up in such a manner that in the event of failure of one of the sets the second is automatically started.

The system includes supervisory means, by which

(Concluded on page 53)

The Effect of Inverse Feedback on Input Impedance

J. B. EARNSHAW, B.Sc.(Hons.), Physics Department, Auckland University College

The use of inverse feedback to modify amplifier gain and distortion characteristics is widespread, and many publications have appeared on the subject. However, at the same time, inverse feedback alters the input and output impedances of the amplifier. This article is mainly concerned with the effect of inverse feedback on the input impedance of audio frequency amplifier stages which is of importance to the matching and frequency compensation of pick-ups, microphones, etc. Consequently it omits the valve inter-electrode capacities in the development of the equivalent input circuits. The method, however, may be extended to include inter-electrode capacities if desired.

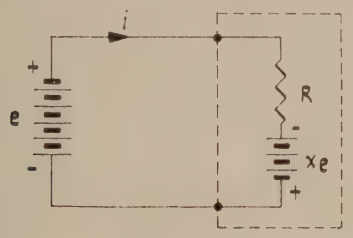


Fig. 1

The input impedance of a circuit is defined as the ratio of the voltage across the input terminals to the current flowing into the terminals. This paper is intended to show that the presence of a resistance of say 500k. ohms, inserted across the input terminals of an amplifier does not necessarily indicate an input impedance of that value.

The example illustrated in fig 1 shows a voltage e applied to the input terminals of a network consisting of a resistance R in series with a voltage xe. The total voltage acting in the circuit $= e + xe = e(1 + x)$

hence the current flowing $i = e(1 + x)/R$

so that the input impedance $e/i = R/(1 + x)$ (1)

Consequently, the input impedance of the circuit is less than R if x is positive and greater than R if x is negative . . . i.e. when the connections on the battery are reversed.

From this result we can see that the input impedance of an amplifier employing inverse feedback can be increased or decreased depending upon the method of applying the feedback.

In fig. 2 circuits 3, 4 and 5 employ inverse feedback in which the feedback voltage is developed across a resistance in series with the output current of the circuits. The phase of the feedback is such that x in (1) is negative and the input impedances are increased.

Circuits 6, 7 and 8 employ inverse feedback in which the feedback voltage is developed across a resistance in parallel with the output voltage of the circuits. Here the phase of the feedback is such that x in (1) is positive and the input impedances are decreased.

With the exception of circuit 2, the input impedance and the gain of each of the circuits, tabulated in fig. 2, can be found immediately from the appropriate equivalent input circuit. The input impedance is obtained from the equivalent input circuit by considering the impedance of the network when viewed from the input terminals, whereas the stage gain is calculated by determining the fraction of the input voltage appearing at the output terminals of the network shown in column I of fig. 2 and assuming that this fraction is fed into an amplifier of constant gain A.

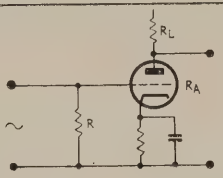
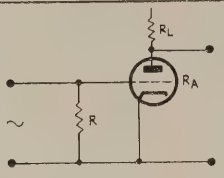
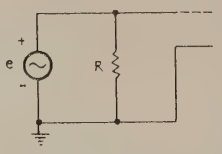
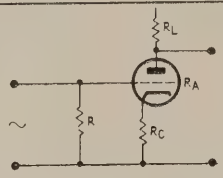
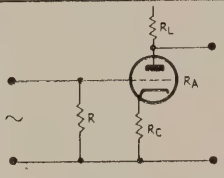
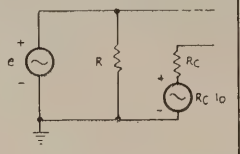
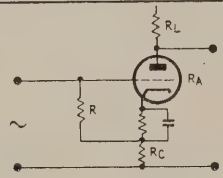
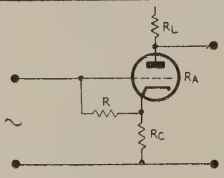
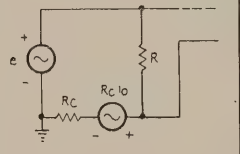
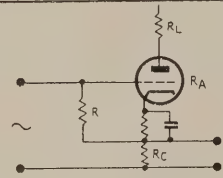
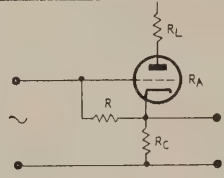
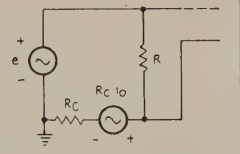
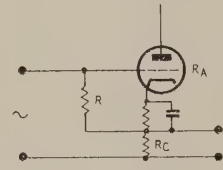
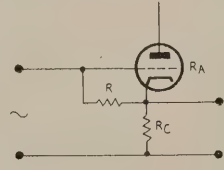
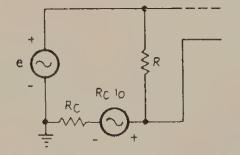
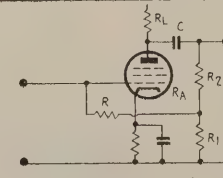
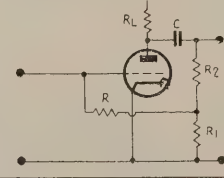
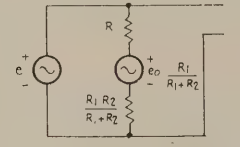
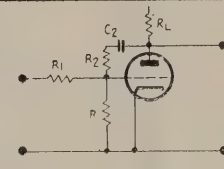
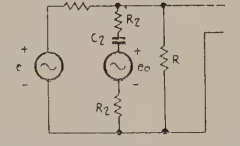
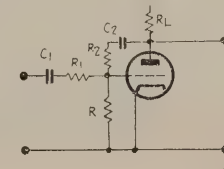
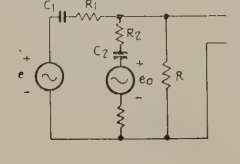
The method of successive simplification from the actual circuit to the equivalent input circuit follows a standard pattern. Firstly the A.C. circuit is drawn and in drawing this, design points arise. In circuit 6, for example, when $R_1 + R_2 \gg 1/C\omega$ we can consider C as a short circuit for the frequencies for which the inequality applies. The input circuit is next to receive consideration, and the feedback network is replaced by its equivalent voltage generator. Circuit 4 provides a good example. Here, the feedback voltage will be $R_c\ i_o$, and the internal restistance of the equivalent generator will be R_c. In deciding the phase of the generator voltage with respect to the input voltage it can readily be seen that a positive voltage on the grid will cause a positive voltage to appear at the cathode, so that the cathode side of the generator in $4C$ and $4E$ will be positive. By ensuring that the equivalent generator internal resistance is small compared with the other components the simple input circuit shown in column E can be obtained.

In the following discussion of the development of the equivalent input circuit the listed symbols will be used throughout:

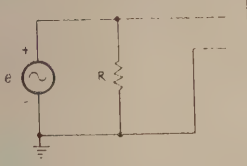
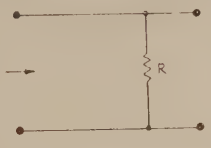
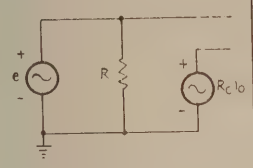
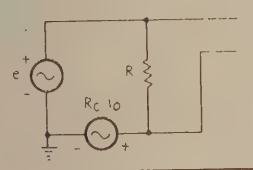
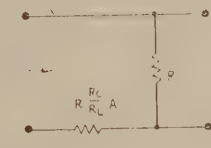
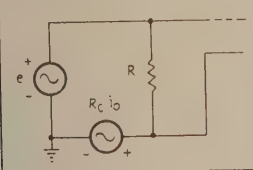
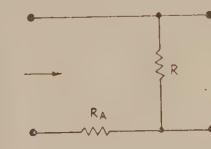
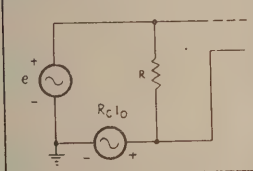
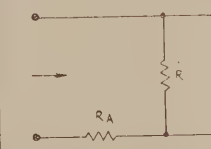
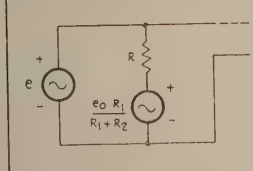
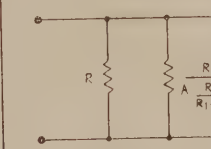
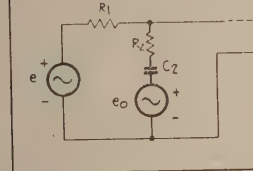
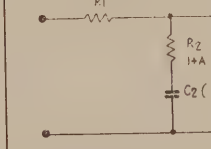
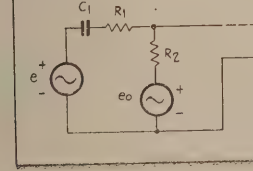
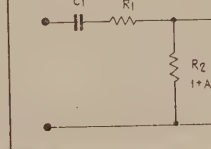
e = input voltage.
e_o = output voltage.
e_g = effective signal voltage between grid and cathode
i_o = output current.
R = grid leak resistance.
R_c = cathode load resistance.
R_L = anode load resistance.
R_A = anode resistance of valve.
μ = amplification factor of valve.
g = mutual conductance of valve.

$j = \sqrt{-1}$.
$\omega = 2\pi f$ where f is frequency in cycles per second.

PAGE 1

	ACTUAL CIRCUIT (A)	A.C. CIRCUIT (B)	INPUT CIRCUIT (C)	CONDITIONS (D)
1				——
2				$R \gg R_C$
3				$R \gg R_C$
4				$R \gg R_C$
5				$R \gg R_C$
6				i) $R_1 + R_2 \gg R_L$ ii) $R_1 + R_2 \gg \frac{1}{C\omega}$ iii) $R \gg \frac{R_1 R_2}{R_1 + R_2}$
7(a)	Low Frequency Boost			i) $R_1 + R_2 \gg R_L$ ii) $\frac{R_2}{R_1} \ll g R_L$ iii) gain rises by 6 db/octave below $f = \frac{1}{2\pi R_2 C_2}$ iv) $R \gg Z_2/(1+A)$
7(b)	Low Frequency Cut			i) $R_1 + R_2 \gg R_L$ ii) $\frac{R_2}{R_1} \ll g R_L$ iii) $R_2 C_2 \gg R_1 C_1$ iv) gain falls by 6 db/octave below $f = \frac{1}{2\pi R_2 C_2}$ v) $R \gg Z_2/(1+A)$

PAGE 2

SIMPLE INPUT CIRCUIT (E)	EQUIVALENT INPUT CIRCUIT (F)	GAIN WITHOUT FEEDBACK = A (G)	GAIN = G (H)	IMPUT IMPEDANCE = Z in (I)
		$A = \frac{\mu R_L}{R_A + R_L}$	$G = A = \frac{\mu R_L}{R_A + R_L}$	$Z\,in = R$
		$A = \frac{\mu R_L}{R_A + R_C + R_L}$	$G = \frac{A}{1 + A\frac{R_C}{R_L}} = \frac{gR_L}{1 + gR_C + \frac{R_C + R_L}{R_A}}$	$Z\,in = R$
		$A = \frac{\mu R_L}{R_A + R_C + R_L}$	$G = \frac{A}{1 + A\frac{R_C}{R_L}} = \frac{gR_L}{1 + gR_C + \frac{R_C + R_L}{R_A}}$	$Z\,in = R\left(1 + \frac{R_C}{R_L}A\right) = R\left(1 + \frac{g}{\frac{1}{R_A} + \frac{1}{R_C} + \frac{R_L}{R_C}\cdot\frac{1}{R_A}}\right)$
		$A = \frac{\mu R_C}{R_A + R_C + R_L}$	$G = \frac{A}{1 + A} = \frac{gR_C}{1 + gR_C + \frac{R_C + R_L}{R_A}}$	$Z\,in = R(1 + A) = R\left(1 + \frac{g}{\frac{1}{R_A} + \frac{1}{R_C} + \frac{R_L}{R_C}\cdot\frac{1}{R_A}}\right)$
		$A = \frac{\mu R_C}{R_A + R_C}$	$G = \frac{A}{1 + A} = \frac{g}{g + \frac{1}{R_A} + \frac{1}{R_C}}$	$Z\,in = R(1 + A) = R\left(1 + \frac{g}{\frac{1}{R_A} + \frac{1}{R_C}}\right)$
		$A = gR_L$	$G = A = gR_L$	$\frac{1}{Z}\,in = \frac{1}{R} + \frac{1}{R}\cdot\frac{AR_1}{R_1 + R_2} = \frac{1}{R}\left(1 + g\cdot R_L\cdot\frac{R_1}{R_1 + R_2}\right)$
		$A = gR_L$	$G = A\cdot\frac{R_2 + \frac{1}{j\omega C_2}}{R_1(1+A) + R_2 + \frac{1}{j\omega C_2}} \doteq \frac{R_2 + \frac{1}{j\omega C_2}}{R_1} \doteq \frac{R_2}{R_1}\left(1 + \frac{1}{\omega^2 C_2^2 R_2^2}\right)^{\frac{1}{2}}$	$Z\,in = R_1 + \frac{R_2}{1+A} + \frac{1}{j\omega C_2(1+A)} \doteq R_1 + \frac{R_2}{gR_L}\left(1 + \frac{1}{j\omega C_2 R_2}\right)$
		$A = gR_L$	$G = A\cdot\frac{R_2}{R_2 + (1+A)\left(R_1 + \frac{1}{j\omega C_1}\right)} \doteq \frac{R_2}{R_1 + \frac{1}{j\omega C_1}} \doteq \frac{R_2}{R_1}\cdot\frac{1}{\left(1 + \frac{1}{\omega^2 C_1^2 R_1^2}\right)^{\frac{1}{2}}}$	$Z\,in = R_1 + \frac{1}{j\omega C_1} + \frac{R_2}{1+A} \doteq R_1\left(1 + \frac{1}{j\omega C_1 R_1}\right)$

Using circuit 3 as an example of current feedback, and referring to diagram 3E, we can see that the input voltage, e, is connected between grid and earth. The feedback voltage is $R_c i_o$ and the circuit is assumed be connected to an amplifier of gain A. The voltage on the grid

$$e_g = e - R_c i_o \qquad \text{.....(2)}$$

and since this is applied to an amplifier of gain A

$$e_o = -R_L = -Aeg$$

the negative sign arises since the anode voltage is out of phase with the output current. From this expression the output current

$$i_o = A.\frac{1}{R_L}.e_g \qquad \text{..... ((3)}$$

and substituting this in (2)

$$e_g = e - A.\frac{R_c}{R_L} e_g$$

hence

$$e_g(1 + A.\frac{R_c}{R_L}) = e$$

and since $e_o = Ae_g$

$$e_o = -Ae/(1 + A\frac{R_c}{R_L})$$

therefore the stage gain is

$$\frac{e_o}{e} = \frac{A}{1 + R_c/R_L.A} \qquad \text{..... (4)}$$

and this is a well-known result.

The current flowing through the grid leak is i where

$$i = (e - R_c i_o)/R$$

hence $e_g = Ri = e - R_c i_o$

and substituting for i_o from (3)

$$Ri = e - A\frac{R_c}{R_L}.e_g$$

therefore

$$Ri = e - A\frac{R_c}{R_L}.Ri$$

or rearranging

$$Ri(1 + A.\frac{R_c}{R_L}) = e$$

so that the input impedance

$$\frac{e}{i} = R(1 + A.\frac{R_c}{R_L}) \qquad \text{..... (5)}$$

Diagram 3F represents two resistances

$$R \text{ and } A\frac{R_c}{R_L}.R$$

in series across the input voltage, and these will present an impedance of

$$R(1 + A\frac{R_c}{R})$$

to the input voltage generator (see (5). The fraction of the input signal appearing at the output terminals of the network—i.e., across R— is

$$\frac{1}{(1 + A\,R_c/R_L)}$$

and this is fed into an amplifier of gain A so that the output from the amplifier will be

$$\frac{Ae_g}{1 + A\,R_c/R_L}$$

resulting in an overall gain of

$$\frac{A}{1 + A\,R_c/R_L}$$

which is the gain as shown by (4). So that the gain and the input impedance are immediately obvious from the equivalent input circuit.

A brief inspection of the individual circuits illustrated in fig. 2 will give some indication of their uses.

Circuit 1. This is a standard triode amplifier stage with no feedback.

Circuit 2. One very common method of feedback application is to leave the cathode resistance unbypassed. This method has the advantage that the input impedance of the circuit remains unchanged, and only the gain and distortion characteristics are modified.

Circuit 3. When a large amount of feedback is required circuit 2 is unsatisfactory since the value of R_c is determined by the d.c. requirements of the valve. In this circuit the bias conditions are maintained by the normal self bias circuit and R_c can be as large as desired. However it must be remembered that the total load of the circuit is $R_c + R_L$ when making calculations of the stage gain (see $2G$, $3G$, $4G$).

Circuit 4. This circuit is essentially the same circuit as circuit 3, except that the output is taken from the cathode circuit; consequently it is in phase with the input. A combination of circuits 3 and 4 is often used as the phase splitting stage in push-pull amplifiers and it can be seen from $3H$ and $4H$ that the two outputs will be equal when $R_c = R_L$.

Circuit 5. In order to include the well known cathode follower, a hypothetical gain without feedback equal to A has to be assumed. Whilst unobtainable practically it is advantageous to accept it so that the method of calculating stage gain and input impedance remains unchanged.

Circuit 6. Voltage feedback can be used to lower an input impedance without loss of gain, provided the comparison is made between two amplifiers doing the same job. By this it is meant that the comparison is made between two amplifiers with the same input impedance rather than with the same amplifier with and without feedback. Circuit 6 illustrates this principle and the circuit can be used to match the impedance of, for example, magnetic pick-ups.

Circuit 7. Commonly known as the anode follower this circuit is shown in five various arrangements. The basic circuit ($7cA$) shows voltage feedback applied via an impedance network. The stage gain is equal to the ratio of Z_2 *to* Z_1, consequently if Z_2 and Z_1 are made frequency dependent, the gain and the input impedance will vary with frequency.

(a) At low frequencies ($7a$), C_2 reduces the amount of feedback, consequently the gain and the input impedance will both increase. This characteristic is used to compensate for the bass loss encountered in magnetic pick-ups. The frequency below which the gain increases by 6 db/octave is $1/2\pi R_2 C_2$. The gain cannot of course increase indefinitely, but is limited by the "unfedback" gain of the valve.

(b) Diagram 7b shows how the circuit may be modified to provide low frequency cut off. C_1 is acting purely as a coupling condenser, and the equivalent circuit illustrates the design conditions to be considered if the anode follower is to be used as an inter-stage amp.

(To be continued)

ELECTRICAL AND TRADE SECTION

RADIO AND ELECTRICAL APPLIANCE MARKETING

By W. L. YOUNG

THE VALUE OF ATTRACTIVE WELL DESIGNED PREMISES

Retailers in general are now giving much thought and attention to the appearance of their premises and buildings. The removal of a large number of building restrictions has made it possible to consider and proceed with construction which not very long ago would have been impossible.

A very noticeable trend, brought about by today's high cost of construction, is the tendency to "face lift" and renovate. Buildings which today are being renovated would, in many instances, have been demolished pre-war; today's high building costs make re-construction within the old shell of the building the economic answer.

No doubt, readers will be able to call to mind immediately specific old buildings which have been smartened up, given clean exterior lines with the appropriate interior treatment. With the expenditure of a relatively modest sum of money much can be achieved and if work embarked upon is part of a comprehensive plan the financial burden will be spread until the final phase is completed.

The appearance of premises can materially affect turnover. Smart premises are always "eye catching" and draw customers. Like the retailer, the buying public is always on the look out for "something new" and the logical place to watch is the retailer with the modern store. Particularly does this apply to the retailer of Radio and Electrical Appliances which of their very nature are "modern." Before a propective purchaser considers the performance of a new radio, vacuum cleaner, washing machine, iron, etc., they make the initial approach to the item under consideration which appeals to their eye. The appropriate setting for a modern streamlined appliance is a modern well laid out store.

Some sales personnel may claim that they can sell an appliance regardless of surroundings. Sales made in indifferent surroundings are made despite the surroundings not because of them. The best of sales personnel cannot sell unless they have contacts and prospects. The whole purpose of having smart "eye catching" premises is to encourage inquiries and increase the number of contacts and prospects. If passersby are attracted by your premises they will look at your displays. The best of displays suffers if it is in a drab setting. The building forms the frame of the picture which your window presents. Do not spoil the picture by lack of attention to the frame.

While there are some Radio and Electric Appliance stores which leave little to be desired, there are others which fall short of the standards expected of a modern store. Over recent years trading conditions have been so buoyant that competition has not been keen enough to compel retailers to modernise their stores. With the general increase in the supply of consumer goods there is now not only competition within our industry but also competition from retailers handling other types of merchandise. Modern efficient premises are essential to meet this increased competition, particularly if extra turnover is to be achieved to provide the extra profits required to meet continually increasing overhead.

Improvements effected to premises you own serve the double purpose of improving the appearance of your store and at the same time increasing the value of a major asset—your building. If you rent premises, negotiations with the owner can frequently yield results which are mutually beneficial. While it can be claimed that you, as a tenant, get the benefits of improvements the fact remains that the owner is also having his asset improved.

As soon as it is decided to embark on a programme of renovations or improvements, obviously a competent architect or good practical builder should be consulted. While any trader knows the peculiar requirements of his business better than an outsider, when it comes to relating these to practical and economic building alterations expert advice will be well worthwhile.

The average radio and electrical retail store has "evolved" over a period of years. Perhaps it commenced primarily as a radio retail shop with a service department; as time went by electrical appliances were added—Ranges, Refrigerators, Washing Machines and the host of medium sized and small appliances. Then more recently with the return to favour of the record—"records."

Apart from the change in the nature of merchandise handled, there is the change in the nature of the business and the way it is transacted. Credit accommodation is much more readily sought and granted than it was twenty years ago. Many claim that without "Hire Purchase" the benefits of modern electric appliances would be denied to a large number of purchasers. The large majority of traders today offer "terms" and the modern store has to offer appropriate facilities for completion of Hire Purchase agreements.

These trading trends have really changed the nature of the premises required, but frequently they have been carried out without any real provision having been made for them. The finding of the "odd corner" to display (if the word can be misused) is not the answer.

What is required is a survey of the overall space available in order that it may be used to best advantage. Even the smallest savings in waste space can mean the difference between comfort and discomfort; good display and bad display. Apart from space that is at present available, consideration can be given to removing departments right away to other premises to allow more shop space. While it is desirable and normally more efficient to have

your store and service departments housed with your retail premises, circumstances could dictate that either or both be removed to allow ample display.

The retailer should know the relative volume of business being done by departments and their profit earning capacity. This should be a guide to the amount of space that can be allotted to departments. There should be more room for purchasers to move among and inspect the larger appliances. There should be an office where clients can be interviewed regarding financial arrangements. The day of the shop, the counter and the maze behind it is right out—or at least it should be.

How can a customer feel at ease if Hire Purchase information is being collated at a counter with other customers who are probably known to him standing by. The retailer likewise has a better opportunity of ascertaining the client's circumstances when a private interview takes place.

The purpose of this article is not to give "expert advice" on building remodelling, its object is to get retailers to consider their premises in the light of modern trends. Is your store as attractive as it could be? Is there space being mis-used? Would you like more useful space if it could be made available? Have you even seriously sought advice on improving the lay-out of your store? Is your lighting adequate? could the ventilation and heating be improved? The correct answers to these questions can be given only by the occupant of a modern store, Yes, premises are important. They will either expand or restrict your trading. Make sure you are getting the most from your premises, and that they play their full part in the advancement of your business.

CHRISTMAS SALES

Christmas is a time of goodwill, a time when thoughts turn to others and in particular an opportunity is taken to send practical tokens of appreciation to our fellowbeings.

This search for and purchase of gifts gives a distinct boost to retail sales and retailers always look forward to buoyant sales at Christmas. As we go to press there are barely three weeks to Christmas and this means that unless immediate action is taken to make provision for stock required there will be no chance of receiving goods in time to catch this seasonal trade

Despite the impact of the British Wharf Strike consumer goods are, generally speaking, in reasonably plentiful supply and while it will be impossible to secure certain lines there will be others which will form a useful substitute.

This Magazine has, during the year, run a series of articles on Radio and Electrical Appliance Marketing. It is important, however, to realize that the best of marketing efforts are futile if the necessary goods are not available to back up sales promotional ideas which have been put into effect. Traders would be well advised to have a quick look over their stock and of course, in conjunction with this, orders already placed. Should inadequate stock provision appear to have been made for sales, take immediate steps to place urgent orders.

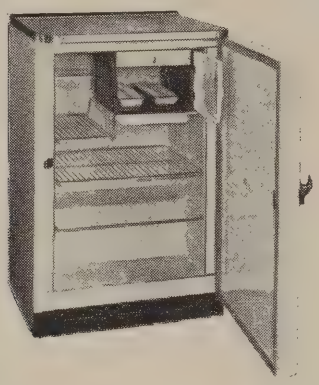
Unlike the greengrocer, Radio and Electrical merchandise is not perishable and if by any chance requirements are over estimated it simply means that orders in the New Year would have to be modified accordingly. How frequently do we hear from Wholesalers that they get last minute calls for stock which, with the best will in the world, they cannot execute. Even when they have that stock it cannot be forwarded to retailers in time because of transport bottle-necks which develop in the week or so before Christmas. All your merchandise should be unpacked and ready for sale prior to the final Christmas burst rather than is often the case, trying to serve and demonstrate to customers at the same time as you are trying to unpack goods which are coming off trucks.

All indications point to record Christmas sales and we wish our readers their share of such sales. However, act immediately and do have that final check of stock so that the record turnover which you are looking for will not be reduced through lack of goods.

NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

This section of our paper is reserved for the introduction of new products and space preference is given to our regular advertisers. For further particulars contact Advertising Manager, R. & E., Box 8022, Wellington.

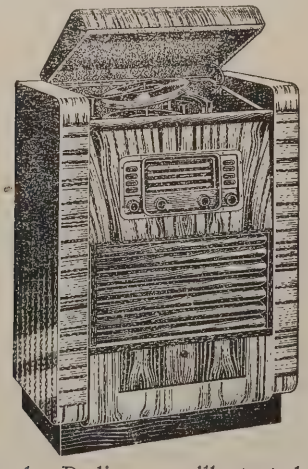
NEECO TABLE TOP REFRIGERATOR



Only work surface high (36 inch Neeco Range Height) the Neeco refrigerator yet has a storage capacity of four and a half cubic feet. Fitted with the famous Coldrator hermetically sealed system, this refrigerator is guaranteed for five years. All shelves are readily removeable. Dimensions are: height 36 in., Width 24½ in., depth 24 in. The door handle projection is 1½ in.

The Neeco Table Top Refrigerator is manufactured and distributed throughout New Zealand by the National Electrical and Engineering Company Limited who have branches in Auckland, Wellington, Christchurch, Dunedin, Hamilton, Wanganui, Hastings, and Invercargill.

THE ULTIMATE 7 VALVE BANDSPREAD CONSOLEGRAM MODEL "EMPEROR"



The Console Radiogram illustrated is a brand new and beautifully veneered ULTIMATE Radiogram, constructed of selected walnut veneers polished to a mirror finish, and housing a powerful and selective 7 valve bandspread receiver in combination with a 3-speed automatic record player with preamplifier section. It uses a 12K Rola Speaker.

Generous provision has been allowed in the cabinet for flat storage of a considerable number of gramophone records, the cupboard measuring approximately 15 in. wide, 5 ft. high and 14 in. deep.

This is an attractive model designed at the request of many dealers to satisfy a popular demand and engineered to give top reception with dependable service.

The code name is "EMPEROR." Manufacturers Radio (1935) Ltd., Quay Street, Auckland.

The retail price is £112.

BRIGHTER AND BETTER

The new model 6P1 from G. A. Wooller and Co. Ltd., which is available now to all Pacific and Regent dealers, is a really bright and colourful radio. It has already proved itself as one of the most popular portables on the market and dealers should find that the new model with its brighter new look, in an attractive two-tone plastic carrying-case, will sell even more readily than before. Retail price £32 10s. 0d.

The tasteful colour scheme of maroon with light grey or grey with ivory, should appeal equally to gay young things and their more conservative parents, while the technical features of the 6P1 should appeal to all who know good radios. It is a 6-valve model that can be operated on A.C. or D.C. power, from its own dry batteries or from a 6 or 12-volt wet battery. We found it pleasantly easy in operation as well as easy on the eye, and tuning is greatly simplified by a large dial. Easy battery changing is another excellent feature of the 6P1 and one that dealers find valuable in their "sales talk."

The Pacific and Regent 6P1 is fully proofed against the effects of high humidity and moisture. This is a feature of all models coming from the Akrad Radio Corporation.

Pacific and Regent models are distributed through-

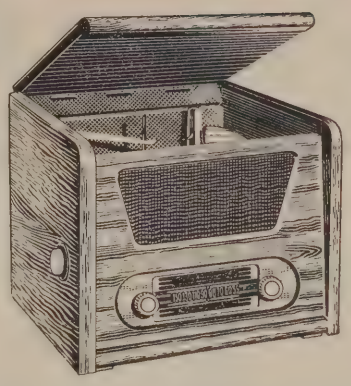
out New Zealand by G. A. Wooller and Co. Ltd., Head Office, P.O. Box 2167, Auckland and branches at 50 Courtenay Place, Wellington, and 604 Colombo Street, Christchurch.

* * * *

THE ULTIMATE 5 VALVE BROADCAST TABLE-GRAM MODEL "MIRO"

The new ULTIMATE MIRO Table-gram illustrated here is supplied in a light or medium oak cabinet The Table-gram employs a Garrard 110 automatic changer, equipped for playing 33⅓ R.P.M., 45 R.P.M., and 78 R.P.M. recordings. The tone is particularly good and the chassis is a 5 valve, Broadcast one, feeding a 69H speaker.

It is felt by the manufacturers, Messrs. Radio (1936) Ltd., Quay Street, Auckland that this Table-gram will enjoy a great welcome by the trade because of its size and portability.



The attractive price of £49 19s. 5d. makes it just the thing for those who want to have compactness in a radiogram without losing tone or performance.

NEWS FROM GOVERNMENT DEPARTMENTS

POST OFFICE

Line of Sight Toll System

The first major toll system over a line of sight radio relay path opened between Wellington and Christchurch on 6th October. The system operates over five radio stations—two terminals and three intermediate repeater stations at Weld Cone (Seddon), Kaikoura, and Manuka Bay. These intermediate stations are necessary to provide, in face of earth curvature and to overshoot hills, the line-of-sight path. Many laymen interested in this new system have been surprised to discover that a straight-line path from Wellington to Christchurch at sea level would pass 6,000 feet below the sea at the half-way point.

Radio Interference

The Post Office receives many complaints about radio interference. One of the major causes of the trouble is faulty electrical gadgets in the home. Generally the intereference occurs when the most wanted programme is on—the electric jug (with an electrical fault somewhere) is put on for that essential "cuppa" just as the hair-raising serial is about to commence.

NEW ZEALAND STANDARDS INSTITUTE

New Industrial Safety Standard

Designed to assist in reducing the number of accidents in industry, of which 1939 involving machinery were reported to the Labour Department last year, a draft standard specification for wire mesh guards, prepared by the Safeguarding of Machinery Committee of the Standards Council, has been circulated to interested parties for their comments.

The need for such a specification was represented to the Standards Council by the Labour Department and several other organizations which were concerned over the growing accident rate among workers operating machinery. A thorough examination of various types of protective apparatus in use in other countries was made by the Safeguarding of Machinery Committee which comprises professional and technical experts from Government Departments and Industrial organizations.

The committee prepared the standard for guards of wire mesh not exceeding 1½ inches which will provide coverage for all types of machinery and machine parts. The guards are of simple design and construction and conform to the provisions of the Factories Act for the protection of workers operating moving machines. However, the specification will not be forwarded to the Minister of Industries and Commerce for declaration as a standard specification until consideration has been given to any comments that may be received.

This specification is the forerunner of a series of industrial safety standards which the Standards Institute has in preparation. A code of practice for the protection of eyes against accidental injury was recently completed, and other specifications in the series will include sheet metal guards and guards for circular saws and all types of woodworking machinery.

Draft New Zealand Standard Specification for Miniature Circuit-breakers for use on A.C. Circuits

A draft standard specification for miniature circuit-breakers for use on alternating current circuits has been prepared by the Electrical Appliances and Accessories Committee of the Standards Council and is now available to all interested parties for their comments. When these comments are received by the Standards Institute, they will be considered by the Committee and the specification will be revised before it is recommended for issue.

The specification establishes requirements in relation to enclosed air-break circuit-breakers, with over-current protection, the main function of which is to prevent continuous overloading of wiring and to clear prospective short-circuit currents up to the valves specified according to their ratings. Where prospective short-circuit currents are likely to exceed the specified values, it may be necessary to provide high rupturing capacity fuses or other back-up protection.

Requirements for construction, safety, methods and times of operation, and the tests necessary to ascertain the suitability of a circuit-breaker for its duty, are included in the specification.

The Standards Institute has circulated the draft specification to organizations and firms who are in a position to make relevant comments, and others who may desire to comment thereon are invited to make application for a copy to the Director, Standards Institute, P.O. Box 195, Wellington.

New British Standard for Resistors and Capacitors

Giving recognition to values which have been used in the industry for some years, a British Standard for resistors and capacitors used in tele-communication has just been published. It specifies a series of preferred values and associated tolerances for fixed wire-wound and fixed composition resistors, and for fixed capacitors. For all practical purposes it is in agreement with publication No. 63 issued by the International Electrotechnical Commission in 1952.

* * * *

EDUCATION AND TRAINING FOR MANAGEMENT

Awake to the growing complexities of management and the increasing difficulty in finding new leaders at all levels of industry, the Education Committee of the Federation of British Industries has recently issued the first of a new series of booklets entitled "Education and Training for Management." In Britain, of course, many of the larger employers are tackling the job of teaching the techniques of management by the use of residential courses, but such methods are out of reach of smaller employers. Thus the latter should find the practical suggestions set forth in this booklet of inestimable value and perhaps their worth would not be lost in New Zealand.

TRADE WINDS

RADIO (1936) LTD. ANNUAL BALL

Happy groups "snapped" at the Radio (1936) Ltd. Annual Ball. Top: Bill Homshaw chatting with Bill Murphy. Left: Mr. and Mrs. R. J. Orbell. Right: Mr. and Mrs. R. S. Levey of J. B. MacEwan's, New Plymouth, and Mr. and Mrs. D. J. Reid, of Auckland. Bottom: President of Social Club, Mr. Dan Mayson presenting Managing Director, Mr. D. T. Clifton-Lewis, Mrs. Clifton-Lewis and Miss Bren Clifton-Lewis with a book and flowers respectively.

The Annual Radio (1936) Limited Staff Ball was held in the Gold Room in High Street, Auckland, on September 3rd. Many of the Radio Retailers throughout the province were present to assist in making this annual event its usual great success. Highlight of the evening was a presentation of a book and flowers to the Managing Director, Mr. D. T. Clifton-Lewis, his wife and daughter, Bren. The illustration shows a presentation being made by the President of the Social Club, Mr. Dan Mayson.

The Radio (1936) Limited Ball has almost become the annual event in the radio trade in Auckland. The hall was tastefully decorated and a Cabaret programme, assisted by artists from the firms own staff, was enjoyed by all. That the evening was a "howling" success is shown by the illustration on this page.

Among those present were: Mr. and Mrs. D. T. Clifton-Lewis, Miss Bren. Clifton-Lewis, Mr. and Mrs. Allan Boulton of Paeroa, Mr. and Mrs. R. S. Levey of J. B. MacEwan and Co. Ltd, New Plymouth, Mr. and Mrs. D. J. Reid, Mr. and Mrs. R. J. Orbell, Mr. and Mrs. D. Alexander of Farmers Trading Co Ltd., Auckland.

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NEECO CONFERENCE 1954

At the Head Office of the National Electrical and Engineering Co. Ltd. (Neeco) a conference was held from Tuesday, September 28th until Friday, October 1st, attended by Managers from all main branches of the Company.

Those present included Messrs. C. E. Fuller, General Manager (Chairman), P. D. England, Sales Manager, J. G. Ritchie, Secretary, E. N. Tewsley, Auckland Manager, R. S. Donovan, Wellington Manager, J. Cunningham, Christchurch Manager, D. H. Short, Dunedin Manager, J. H. Simpson, Wanganui Manager, N. H. Matthews, Advertising Manager, L. E. Exley, Head Office, S. C. MacDiarmid, Engineer, F. K. Garry, Engineer, J. G. Naylor, Engineer, and P. C. Weston, Engineer.

Opportunity was taken towards the close of the Conference to farewell Mr. E. N. Tewsley, retiring Auckland Manager, at a special afternoon tea party. Mr. Fuller, on behalf of the staff, presented Mr. Tewsley with an engraved silver salver as a token of their regard and wished him well in his retirement.

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NEW AUCKLAND SALES REPRESENTATIVE FOR RUSSELL IMPORT CO., LTD.

Russell Import Co. Ltd. advise that Mr. Ray Harrington has been apointed Auckland Sales Representative for their Company. Ray, who was formerly Auckland traveller and latterly branch manager for The Swan Electric Co. Ltd., is well known to the Radio and Electrical Industry in the Auckland Province.

He commenced his duties with Russell Import Co. Ltd., on the 1st November, and after a week in the office at Wellington to familiarize himself with Russell's many popular lines, he started on his territory.

Ray looks forward to meeting his many friends in the Industry, and he feels sure that they will be very interested in the many new and popular lines he is now able to offer.

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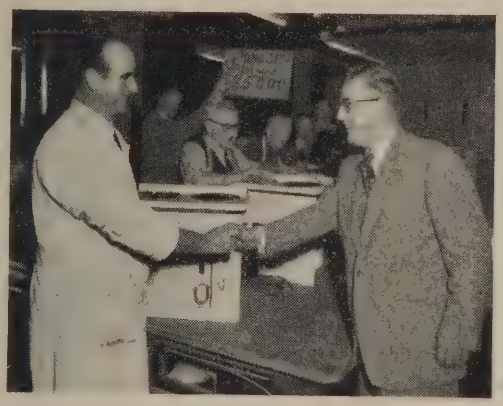
RADIO (1936) LIMITED PRODUCES THE 25,000th RANGETTE



Ultimate Rangettes are known throughout the Dominion and it was quite an occasion in the Ultimate factory in Auckland in July when the Rangette Production Line completed No. 25,000th. Illustrations show the Managing Director, Mr. D. T. Clifton-Lewis shaking hands with the foreman of the Rangette Department, Mr. Reg. Trimble. Con-

gratulations were offered and one can see by the illustration that there was high glee in the Department that day. The making of the first Rangette goes back to 1939 when the first Ultimate which was a 2-hot plate affair even in those days was on the market and had its only competitor in the "Superior," a Canadian model. Since then two elements have been added to the oven, which is now lagged and a radiant element is incorporated. The Rangette has come a long, long way,

We congratulate the Rangette team on production of this high quality product.

In the second picture, Mr. Trimble is shown standing in front of a batch of the newly produced Rangette and at his right-hand is one of the original models, slightly kocked about now but showing that the Rangette has grown in size and quality and today even boasts of a stand.

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N.Z. RADIO, TV AND ELECTRICAL TRADERS ASSN.

A happy group partaking of refreshments at the Hamilton Conference. From left to right: Harold Barr of Wingates, Ltd., "Dusty" Rhodes, of Radio Repairs Ltd., Bill Murphy, of Radio (1936) Ltd., and Bert Peoples, President.

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SUPREME RADIO AND RECORDING SERVICE

Mr. B. A. Holmes, well-known Hamilton radio specialist and recording technician, has now moved to more spacious premises located at "MILTON CHAMBERS," 8 Milton Street, Hamilton, where, besides radio work, he will specialise in high-fidelity audio and recording work.

Latest Overseas Developments in Radio and Electronic Equipment

MULLARD AMPLIFIER CIRCUIT

In accordance with their policy of providing valve users with comprehensive technical information on valve applications, Mullard Ltd. have designed a five valve, ten-watt high quality amplifier circuit, which enables the fullest advantage to be taken of the latest Mullard audio valves. This circuit will help home constructors and equipment manufacturers to build a high performance amplifier at a comparatively low cost.

POCKET PORTABLE RADIO

From America we hear of the manufacture of a new pocket portable radio offering a day-time reception of nearly 50 miles. This little set, manufactured by Privat-Ear Corporation of Blacksburg, Va., uses subminiature tubes with a diode crystal detector in a unique circuit. Overall dimensions are 2¼ in. wide, 5¾ in. long, and ⅞ in. deep. Weight with batteries and built-in antenna is 8 oz.

DECADE CAPACITOR BOX FOR UNIVERSAL USE IN LABORATORY, FACTORY AND SERVICE DEPOT

Developed by Winston Electronics Ltd. Middlesex, England, a new type of decade capacitor box has just appeared on the English market.

The new type of eleven-position switch developed, and now patented, reduces bulk and manufacturing costs.

Not only has the Decade Capacitor Box proved useful in servicing deaf aids, but it has wide application in electronic circuit designing and building, production control and testing, research, technical and teaching laboratories, and, in fact everywhere electrically in many industries. Its small size, lightweight, and portability make it invaluable to the service engineer.

Technical Specifications:

Range: 0.001 microfarads to 1.11 mfd. in 0.001 mfd. steps.

Stray Capacitance: Less than 15 pfs. per decade.

Working Potentials: 500 volts D.C., except the 0.1 mfd. range where it is 300 volts D.C.

Switching: Positive, firm, finger-ready, no play.

Finish: Facia Panel Photo etched: Box, Steel grey hammertone enamel.

Weight 32 oz.

Dimensions: 8 in. x 3¾ in. x 3 in.

* * * *

Small precision transformers for intermediate-frequency radio and television circuits are produced at low costs with durable frames made of C-11 plastic. With the aid of this new material compact transformers with uniform high electrical performance have been mass produced at low cost. Developed by Automatic Manufacturing Corporation, Newark, New Jersey, U.S.A., this small but versatile transformer adapts easily to four different circuit applications. A non-warping frame to support core and coils is moulded of C-11 plastic which has very good high-frequency insulating properties, impact strength, and dimensional stability. The delicately tuned adjustment of core and coils which maintains high electrical performance would be upset by the slightest distortion of the frames. According to the manufacturer, these frames are safe for use at temperatures as high as 194 deg. F. (90 deg. C.). Coolant oil used in threading the core does not affect C-11 plastic which resists most chemicals. Standing about 2½ (6.4 cm.) inches high, this transformer is made in a variety of types all assembled from the same components for use in broadcast, FM radio and television receivers.

* * * *

A.M./F.M. SLIDE SWITCH

With the prospect of the B.B.C. introducing a regular F.M. service in the near future, a demand has arisen for universal A.M./F.M. domestic radio receivers. To satisfy the requirements of these receivers, the Plessey Company are manufacturing a wide range of special components, to which they have now added a slide switch suitable for use as an A.M./F.M. selector.

The switch is built in the form of two bars of insulating material. Fixed contacts are mounted on one bar, while moving contacts are on the other, sliding bar. It can be operated from the normal wave-change switch by means of a cam which fits directly on the end of an H-type switch spindle. Alternative contacts are available to give either a make-before-break or a break-before-make action.

The design is extremely versatile, and switches may be constructed in any convenient length, the contacts, which are of the self-wiping type, being arranged in groups of three at set intervals along the bars. This form of construction lends itself to the adoption of an efficient chassis layout with extremely short wiring, so that the switch is ideal for use as a selector in dual-frequency I.F. stages. The switch can also be used for wave-changing in receivers requiring only two positions, such as those limited to use on the M.W. and V.H.F. bands.

Fixing brackets at each end of the insulator bars enables the switch to be mounted in a horizontal or a vertical plane. An additional bracket is provided, when required, for mounting in an intermediate position to strengthen extra-long assemblies.

* * * *

NEW MINIATURE TV CAMERA

Designed for use in all branches of industry, and particularly for remote viewing of dangerous or inaccessible processes, the new Pye television camera is remarkable for its low cost and running expenses and the simplicity of its operation, the latter being within the grasp of any layman. The weight of the camera is only thirty pounds.

For nearly three hours, world-famous surgeons gathered in London for a meeting of the British Association of Pedriatic Surgeons, clustered round half a dozen television receivers in the first floor lecture room of the Great Ormond Street Hospital, London, while a miniature Pye television camera, situated in the operating theatre five floors above, peered over the shoulders of surgeons conducting a number of important operations on young children.

Experts from Pye also watched the TV screens with interest; for them the great problem was whether their newly-developed camera, costing only a few hundred pounds, would be adequate for the exacting task of showing the minutest details beneath the surgeon's scalpel.

Later, the surgeons were unanimously enthusiastic about the television's success as a teacher, the general opinion being that teaching hospitals all over the country would welcome similar inexpensive equipment.

* * * *

REVISED STANDARD FOR MAGNETIC TAPE

Specifying the requirements for recording on magnetic tape and of the associated recording and reproducing equipment necessary for the successful interchange of recordings for broadcasting or similar purposes, the British Standards Institution has recently issued a revised standard entitled "Magnetic Tape Sound Recording and Reproduction for Programme Interchange." The recording and reproducing characteristics are those adopted by the Comité Consultatif International Radiophonique (C.C.I.R.).

MORE TAPE RECORDING EQUIPMENT FOR B. B. C.

In expanding its facilities for recording sound programmes on magnetic tape, the B. B. C. in a little over two years has spent approximately a quarter of a million pounds. New recording equipment has been installed on a considerable scale, the suppliers being Electrical and Musical Industries Ltd., the Radio Gramophone Development Co. Ltd., and the British Ferrograph Recorder Co. Ltd.

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ELECTRONICS IN MEDICINE—SOUND TREATMENT

The latest treatment of bone diseases involves the use of supersonic ray apparatus. Previously, for these complaints it was possible to give only temporary relief, but now supersonic rays have been found capable of breaking down lime deposits and making hitherto rigid joints supple and usable.

Selling "Over the Counter": The Legal Position

As it applies in Great Britain

C. F. MAYSON

(Reprinted with acknowledgements to the "Electrical Review")

The dismissal by the Court of Appeal of the appeal against the decision of the Lord Chief Justice in *Pharmaceutical Society of Great Britain v. Boots Cash Chemists (Southern) Ltd.*, brings into prominence the oft-debated question of whether a trader can be compelled to sell an article which he exposes for sale in his shop or shop window.

Any transaction between a trader and his customer is a contract, the basis of which is the agreement between the parties, arrived at by a process of offer and acceptance. The contract is made when a bargain is reached. In other words, one party promises something to the other, who accepts the promise and, in return, gives a *consideration,* "the price of the promise." The law implies that the parties, by these acts, intend that their relationship shall be on a legal basis.

BASIS OF TRANSACTION

The fundamental fact about sales "over the counter" which has been confirmed in the *Pharmaceutical Society* case, is that the display of goods anywhere on the premises is not an "offer" in the legal sense, but is an invitation to potential customers to make an offer to buy. The real offer is made when the customer asks for a particular article on display; the acceptance is by the shopkeeper, which may be expressed by him in words, or may be implied by his taking the cash.

We all know what happens in practice. Green, a potential customer, comes into Brown's shop and says to him, "I see you have an 'X.Y.Z.' toaster in the window. How much is it?" Brown states the price. Green replies, "I'll have it," and, while Brown wraps it up, Green pays over the money. Although there are many variations in this procedure, this is what has, in fact, occurred. Brown, by displaying the toaster, has said, in effect, "This is for sale to the buyer who will pay the price." Green, in inquiring the price, is asking for information, which is provided by Brown. The effective offer is made by Green saying he will take the toaster, and Brown accepts the offer by wrapping it up. Green has promised to pay so much in return for the toaster, and Brown has accepted the promise, giving the toaster as consideration.

MARKED PRICE NOT BINDING

The consequence of the offer being made by the customer, and not the trader, is thus. No trader can be compelled to sell anything which he puts on display and, further, he need not sell at the price marked on the goods; the latter merely indicates the figure at which the trader is willing to sell. This is extended to advertised articles, to the prices given in such advertisements. Thus, should a marked price be incorrect, the seller can get out of his difficulty either by refusing to sell at all or by making a counter-offer at a revised price. A counter-offer is a rejection of the original offer, and it would then be for the customer to accept as he thought fit. However, most traders prefer to sell at the marked price rather than risk their goodwill and reputation; which is, perhaps, why it is so generally assumed that an article placed on display must be sold when asked for, unless it is marked "Not for sale."

Strictly speaking, once the offer has been accepted, neither party can withdraw. But the English Sale of Goods Act, 1893, Section 28, provides:

> "Unless otherwise agreed, delivery of the goods and payment of the price are concurrent conditions, that is to say, the seller must be ready and willing to give possession of the goods to the buyer in exchange for the price, and the buyer must be ready and willing to pay the price in exchange for possession of the goods."

"Unless otherwise agreed,, means, of course, unless the trader is giving his customer credit. In the ordinary course, therefore, there is no concluded contract "over the counter" until the customer's offer to buy has been accepted by the trader receiving the money, when he is compelled to hand over the goods.

The *Pharmaceutical Society* case has decided that a transaction in a "self service" shop is no different from any other. The customer who picks up an article and takes it to the counter is making the offer; the acceptance is by the assistant who takes the cash. Just as in any other shop, the customer's offer may be refused without any reason being given. The use of the word "offer" in this context is not to be confused with its use in connection with price control by regulations. An offence may be committed if goods are "offered" to the public at other than the controlled price, and such an offer (which is merely an invitation to offer to buy) has been held to include the display of goods, with price attached, in a shop window.

Once the contract has been concluded either by the acceptance of cash or the giving of credit, the property in the goods (that is, the right to do as one likes with them) passes to the buyer, provided the actual goods have been appropriated to the contract. Risk in, and responsibility for, goods is with the person who has the property, but the property, and therefore the risk, does not pass to the buyer until the goods have been actually ascertained and appropriated to the contract. Thus, a customer says, "I want twelve 60 W. lamps." Until twelve actual lamps are taken out of stock and earmarked to that order, no property in them can pass to the buyer. But where the property has passed, and the seller is still in possession, the latter retains the risk as a bailee. It does not pass to the buyer until the goods have been delivered either to the buyer himself (or

(Continued on page 53).

Some Import Figures

RETURN SHOWING PARTICULARS OF CERTAIN WIRELESS APPARATUS ENTERED FOR IMPORT INTO NEW ZEALAND DURING THE SIX MONTHS ENDED 30th JUNE, 1954.

Item and country of origin	Number	£(N.Z.)
Valves for receiving sets:		
United Kingdom		2,139
U.S.A.		21
Total		2,160
Transformers for receiving sets:		
United Kingdom	86,427	20,241
Canada	1,399	382
Australia	23,915	4,940
Netherlands	135,478	26,841
U.S.A.	8,598	4,629
Total	255,817	57,033
Valves for Transmitting Sets:		
United Kingdom	2,614	8,945
Australia	14	250
Netherlands	135	326
U.S.A.	382	3,712
Total	3,145	13,233
Receiving Sets, Built up but Not Mounted in Cabinets:		
United Kingdom	29	2,479
Australia	30	5,518
Total	59	7,997
Receiving Sets Mounted in Cabinets:		
United Kingdom	144	5,163
Germany—Western Zone	1	17
Netherlands	4	79
U.S.A.	1	35
Total	150	5,294
Transmitting Apparatus—Other Than Valves:		
United Kingdom		19,003
Australia		269
U.S.A.		233
Total		19,505
Other Wireless Apparatus:		
United Kingdom		146,268
Union of South Africa		21
New Zealand		53
Australia		24,681
Denmark		297
France		1,128
Germany—Western Zone		4,280
Italy		1,299
Netherlands		10,396
Sweden		1,783
U.S.A.		7,226
Total		197,432

The values shown above represent the current domestic values in the countries of export expressed in terms of New Zealand currency.

Classified Advertisements

FOR SALE.—Soundmirror tape recorder, unused, latest model, price £50. Apply Wright, 90 Pitt Street, Wellington.

WANTED TO BUY.—Inductor dynamic speaker. The Radio Service Co., 83 Guyton Street, Wanganui.

FOR THE TECHNICIAN

Instructions for Servicing the NEECO Sovereign F503 Model Range

To change top:

Lift out plug-in "Radiant Heat" Elements.

Remove back panel.

Unscrew top (one screw in each 6 in. surround recess).

Lift top from back, and move forward.

When fitting new top, hook top locking angle inside holding lugs in front of range top. This locking angle is adjustable to allow for snug fit of top.

To change sides:

Disconnect range from main supply and remove warmer and utensil drawers.

Remove top (see above).

Lay range on its back and remove door.

Right side:

Remove panel from fuse compartment (one screw in bottom) (fuse compartment).

Remove screw from top fuse (right hand).

Remove hinge lock stop bracket support panel. (Two screws in front frame lower leg, two screws inside top of base and two screws in oven case bottom).

Remove two ¼ in. screws in bottom of side and base.

Stand range upright and remove two screws from each cross-bracing channels (right side).

Remove two screws from oven case back and side.

Lift side away.

(On replacing new side this process should be reversed).

Left side:

Same operation as above.

To remove switch and fuse bracket:

Remove all switch and control knobs.

Lift off switch panel.

Remove fuse panel (one screw in base).

Remove two screws in top of switch bracket, two screws in centre of switch bracket, and two screws in bottom of switch bracket.

Lift out switch bracket complete.

NOTE:—Enough slack wire has been left to enable serviceman to withdraw switch bracket to reasonable working position.

To change door mainspring:

Remove utensil drawer.

Pull hinge lock off pin in bottom frame and forward out of stop bracket to relieve tension on spring.

Unhook spring off hinge-lock and door hinge.

Hook new spring on hinge first, then on hinge lock.

Pull hinge lock up through slot in front frame below pin.

Hold the bottom end of hinge-lock back in line of slot in stop-bracket and top hinge-lock in until slot drops into place on pin in front frame.

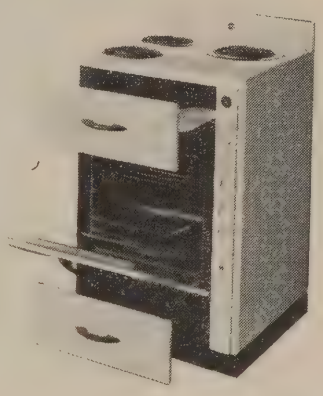
To fit new door:

Remove plug-in elements and top and bottom drawers.

Place range on its back.

Fit hinges to inside door panel and leave slack; position door panel on hinge pins and check alignment with range sides and clearance at oven top. Tighten up screw.

Clearance at door bottom with front frame when door is closed, should be 3/32 in., hinge pins to bear at top of slots when making these checks.



Drill centre holes and fit screws; tighten screws firmly.

By opening and closing panel, check alignment of hinges with slots in front frame throughout their entire movement. Lag screw on outside door panel. See that lagging is evenly distributed.

With panel closed attach springs to hinge and hinge locks. Place hinge locks in position on bottom pin in front frame and hinge lock stop bracket.

Check locks to see that they are in centre position of slot in hinge lock stop brackets, adjust brackets if necessary.

By opening and closing door see that both hinges are striking centre of rollers at the same moment. If necessary adjustment is made by moving hinge lock stop brackets.

See that brackets are tightened up firmly.

Replace range in upright position and test door for closing. Grease all working parts.

Check friction springs for holding door in fully open position, increasing tension by resetting springs if necessary.

To change oven lining:

Remove back panel and terminal cover box.

Disconnect lead wires from terminal block and oven element contacts.

Remove tile holders, tiles and contacts from oven case back. Remove oven case back.

Remove oven element support buttons from inside top and bottom of oven lining.

Remove oven support channels.

Oven lining is now free to be pushed out through front frame. Care should be taken to see that lining slides out square and that "Insulwool" lagging is not disturbed.

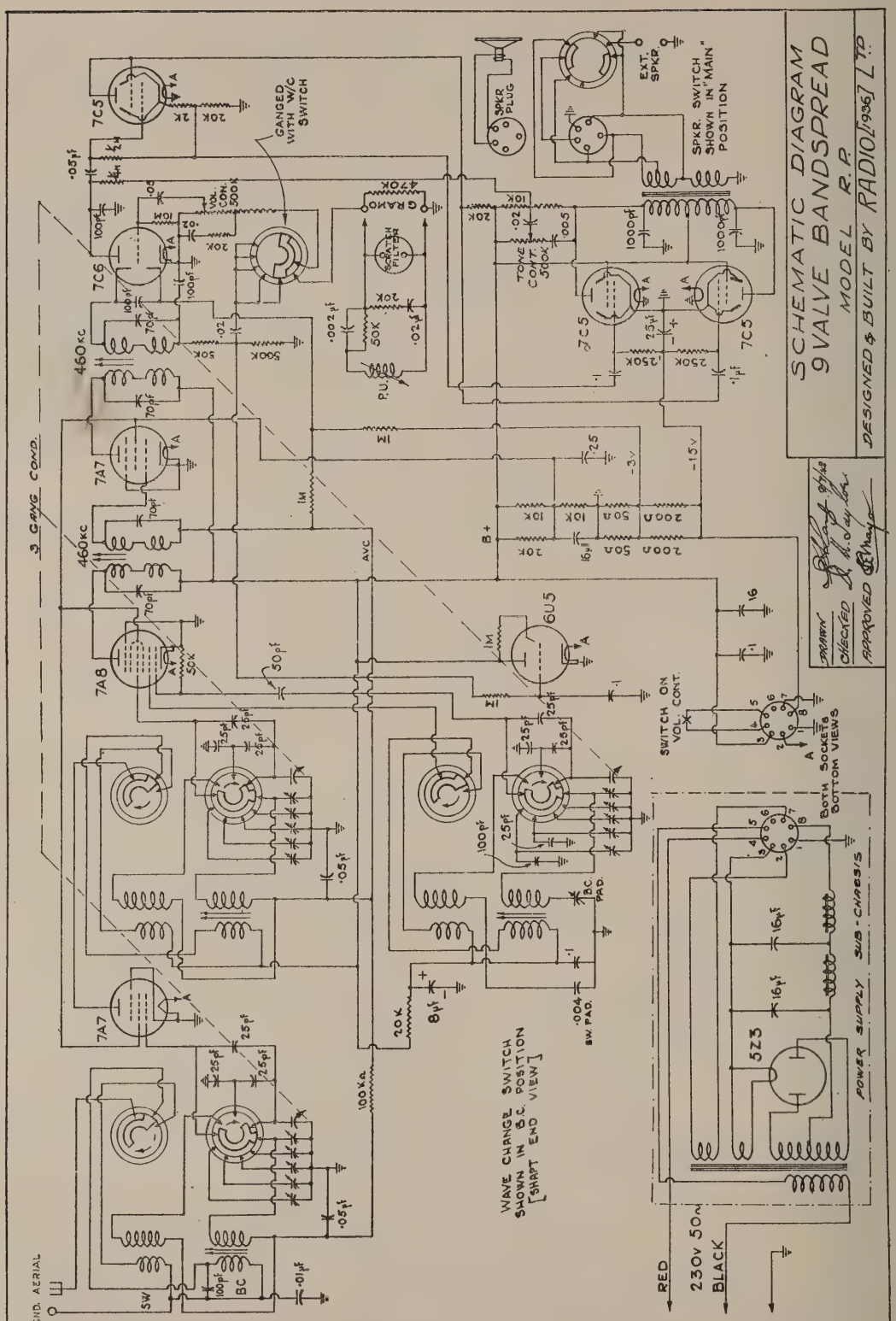
To instal new lining this procedure is reversed.

NOTE.—See that oven **slide support** buttons are at top of oven lining before sliding into front frame.

To remove plug in radiant heat elements:

Firstly open top drawer and ease plug from pocket with one hand while lifting out element with the other, in replacing same check plug contacts for alignment.

THE "ULTIMATE" MODEL RP



Telecom. in Development

(Continued from page 36)

any untoward incident or failure in operation of any of the equipment at the unattended repeater stations is automatically indicated to one of the terminal stations of the system. This enables the maintenance engineer to travel to the repeater in good time to make the necessary repairs or adjustments and avoid interference to the system.

There is unquestionably a big future for "repeatered" radio communications operating on frequencies higher than 60 Mc/s and up to 7,000 Mc/s or higher for use in territories where an underground cable system of the type in use in U.K. is not a practicable proposition.

Apart from the use of multi-channel systems for trunk purposes, single-channel VHF communication can be laid on to isolated estates, police stations or private residences or Government offices. For such purposes it is rarely economic or practicable to provide a normal telephone line system. Radio will now maintain communications that would otherwise have to be conducted by road vehicle or runner.

Malaya is a particular example. More than 2,000 VHF radio communication sets have been installed in police stations, mines and estates in order to give rapid communication in the event of bandit attacks or suspected approach.

"Selling Over the Counter"

(Continued from page 49)

his agent), or to a carrier (which includes the Post Office).

The question of appropriating goods to the contract has one snag: appropriation may be unintentional. Suppose a customer, selecting a refrigerator in a dealer's showroom, says to the salesman, "I'll take that one," pointing to a particular machine. If it is agreed or understood that that refrigerator is actually for sale and is not a mere "showroom model," it is immediately appropriated, and the delivery of another, though identical machine will not fulfil the contract. Should the salesman fail to make it clear that the machine selected is a sample, not intended for sale, and he accepts the customer's offer to "take that one," the dealer will be in breach of contract if he does not deliver it; and, what is more, he must ensure that it is in full working order and in saleable condition.

* * * *

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Note:—the "Moving Finger" in this case, is the needle of the volume indicator meter.

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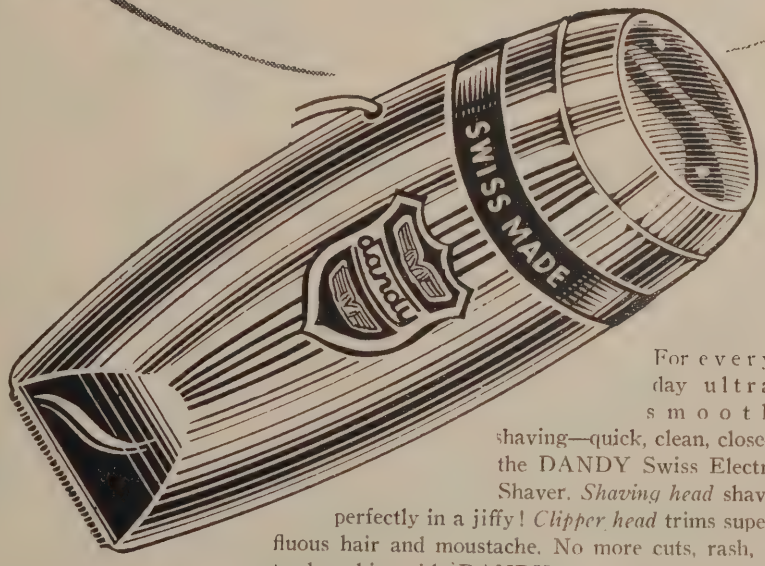

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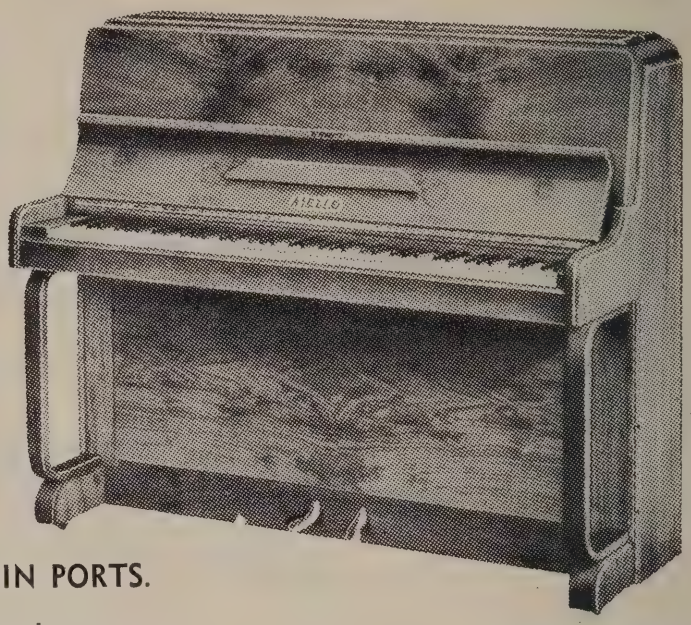

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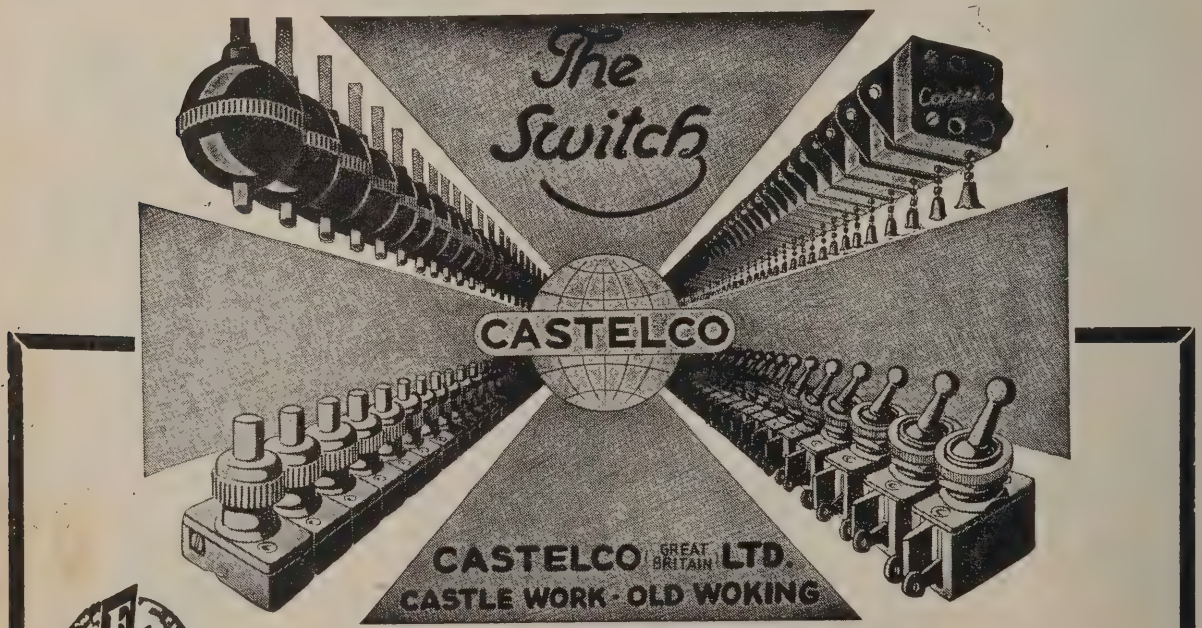

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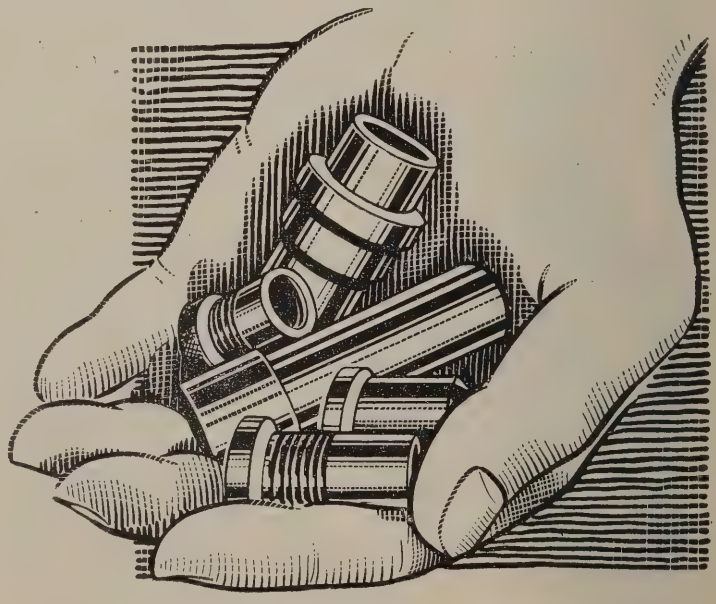

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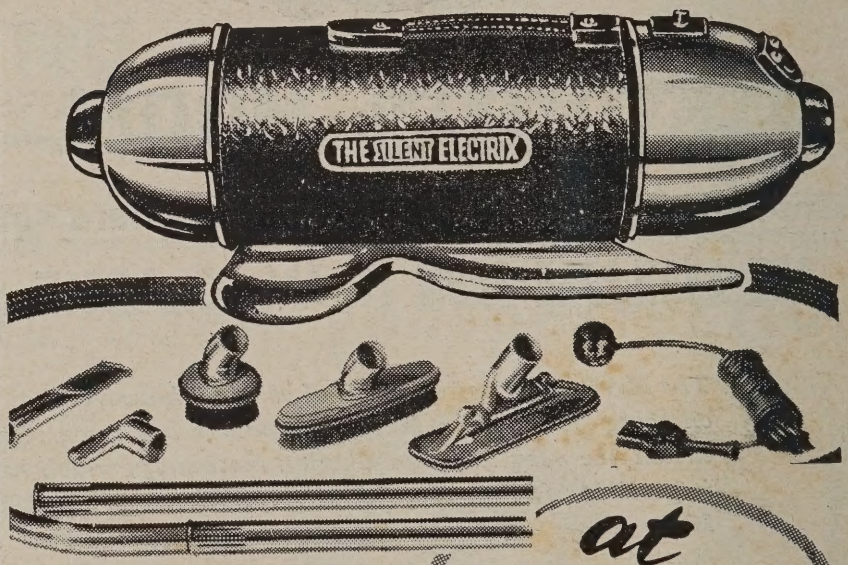

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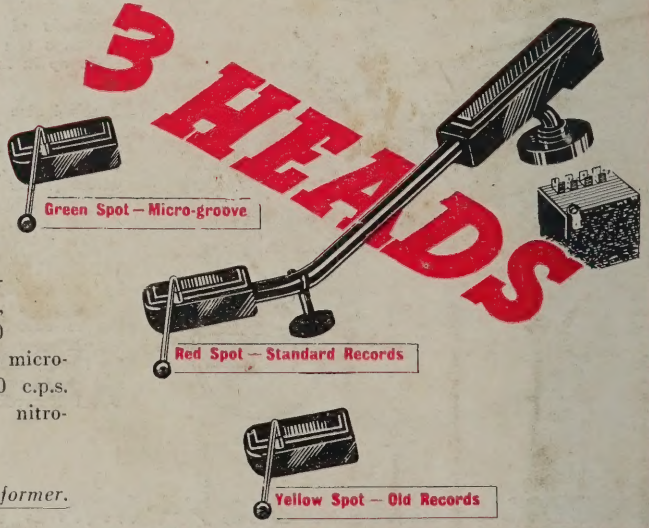

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